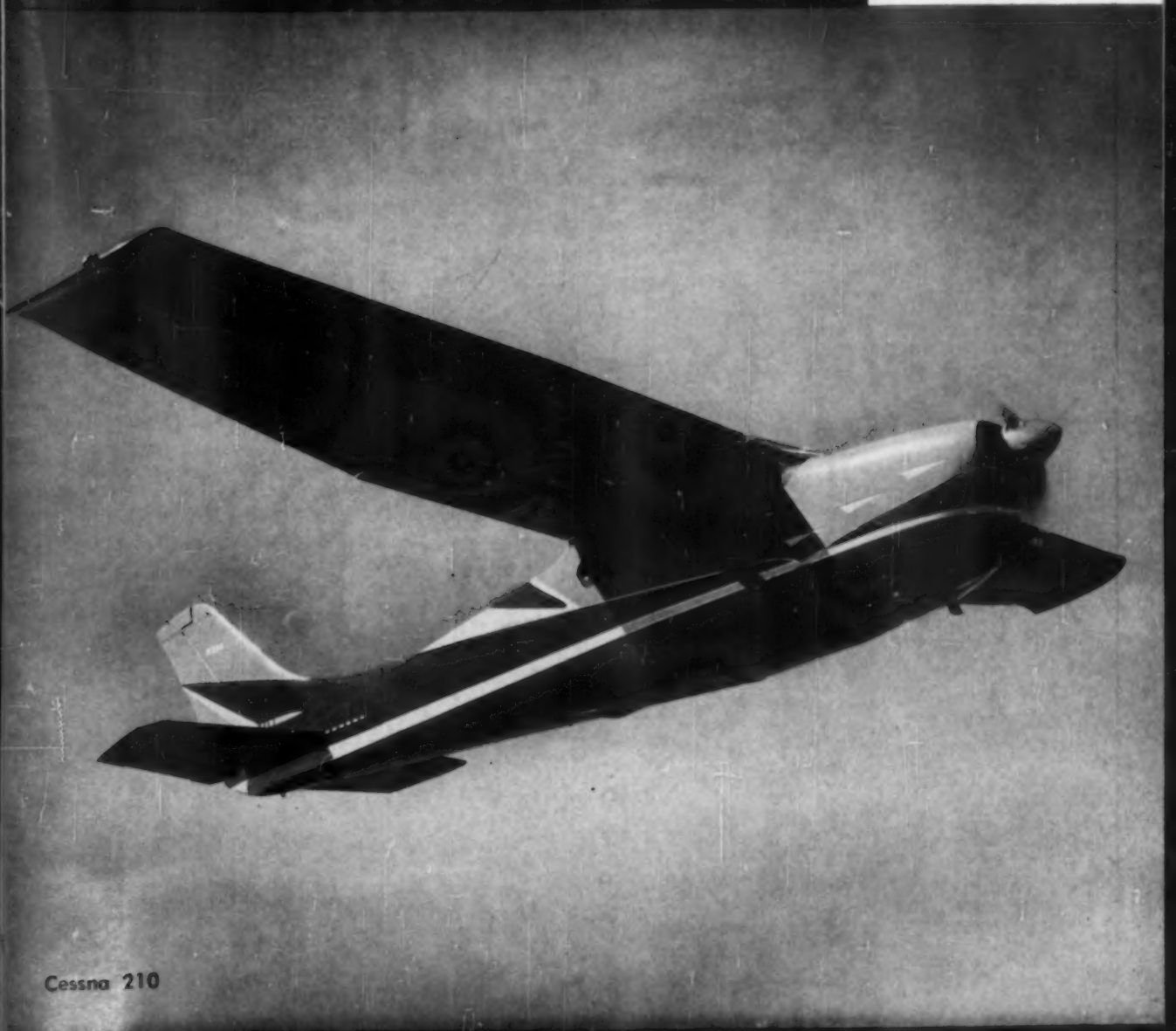
Aviation Week

Including **Space Technology**

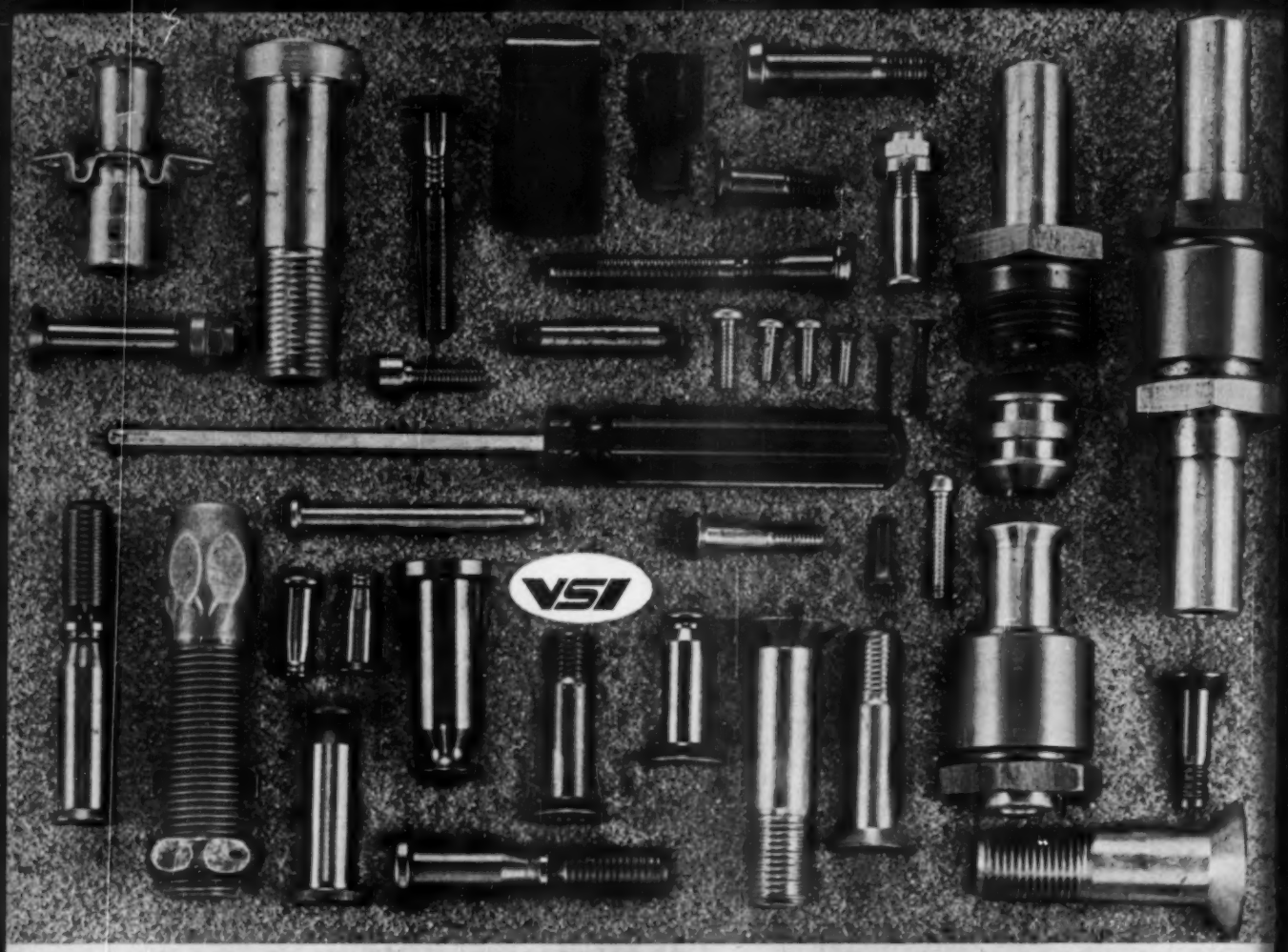
August 31, 1959

Pilot Report On Cessna 210



Cessna 210

Details of



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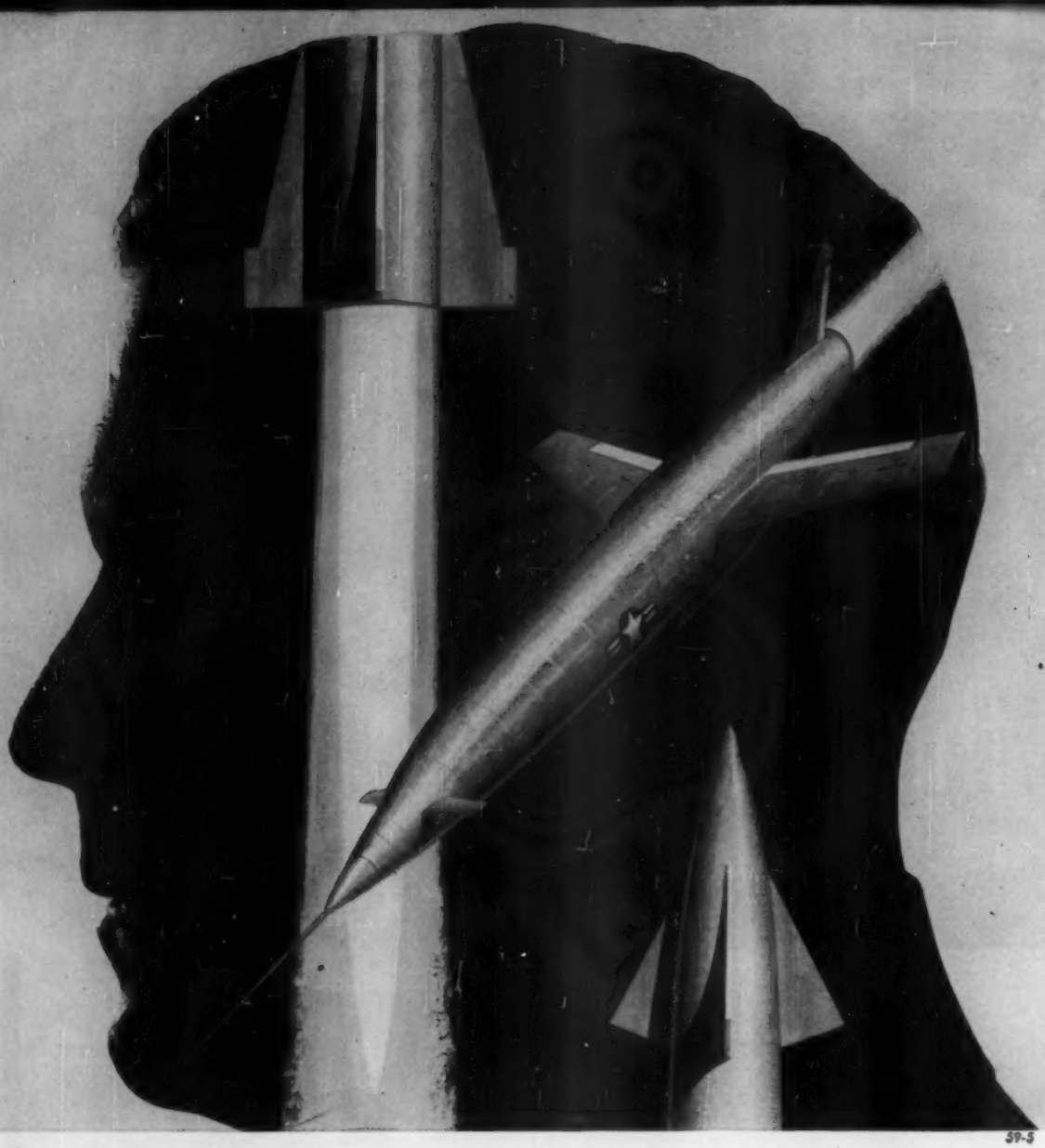

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AVIATION CALENDAR

Sept. 7-13—1959 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.

Sept. 9-11—Sixth Midwestern Conference on Fluid and Solid Mechanics, University of Texas, Austin, Tex. Sponsors: AFOSR/Directorate of Aeronautical Sciences; Office of Naval Research; National Science Foundation.

Sept. 10-11—14th Annual Meeting, Armed Forces Chemical Assn., Hotel Statler-Hilton, Washington, D. C.

Sept. 14-15—Display of USAF Ground Support Equipment for Manned and Unmanned Aerospace Vehicles, Society of Automotive Engineers, Milwaukee Arena, Milwaukee, Wis.

Sept. 16-17—Western Regional Meeting on Frontiers of Science and Engineering, Institute of the Aeronautical Sciences, Los Angeles, Calif.

Sept. 17-18—Conference on Effects of Nuclear Radiation on Semiconductors, Western Union Auditorium, New York, N. Y. Sponsor: Army Signal Corps.

Sept. 19-20—National Air Races (190 cu. in. airplanes), Baer Field, Ft. Wayne, Ind.

Sept. 20-25—14th Annual Conference and Exhibit, Instrument Society of America, Chicago Amphitheater, Chicago, Ill.

Sept. 21-22—Conference on Planning and Designing of Urban Helicopter Facilities, Institute of Aeronautical Sciences Bldg., Los Angeles, Calif. Sponsor: Los Angeles Chamber of Commerce.

Sept. 21-22—Eighth Annual Meeting, Standards Engineering Society, on Investment in Survival, Somerset Hotel, Boston, Mass.

Sept. 21-25—14th Annual Instrument-Automation Conference and Exhibit, Instrument Society of America, Chicago, Ill.

Sept. 23—Second Semi-Annual Area Meeting, Washington Air Route Traffic Control Center, Mariott Motor Hotel, Washington, D. C.

Sept. 23-24—Engine and Operations Sym-

(Continued on page 6)

AVIATION WEEK Including Space Technology

ABC

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Screen Voltage (Maximum DC)	275 volts	325 volts	—
Peak Plate Voltage (Max. Instantaneous)	550 volts	750 volts	—
Plate Dissipation (Absolute Max.)	14.0 watts	30 watts	—
Screen Dissipation (Absolute Max.)	2.0 watts	3.5 watts	—
Heater-Cathode Voltage (Max.)	±450 volts	±450 volts	±500 volts
Grid Resistance (Maximum)	0.1 Megohm	.1 Megohm	—
Grid Voltage (Maximum)	5.0 volts	0 volts	—
(Minimum)	-200 volts	-200 volts	—
Cathode Warm-up Time	45 sec.	45 sec.	45 sec.

*For greatest life expectancy, avoid designs which apply all maximums simultaneously.

**Voltage should not fluctuate more than ±5%.

MECHANICAL DATA	6094	6384	6754
Base	Miniature 9-Pin	Octal	Miniature 9-Pin
Bulb	T-6½	T-11	T-6½
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Maximum Seated Height	2⅝"	2¹⁵⁄₁₆"	2½"
Maximum Diameter	⅞"	1⅞"	⅞"
Mounting Position	Any	Any	Any
Maximum Altitude	80,000 ft.	80,000 ft.	80,000 ft.
Maximum Bulb Temperature	300°C	300°C	300°C
Maximum Impact Shock	500G	500G	500G
Maximum Vibrational Acceleration	50G	50G	50G

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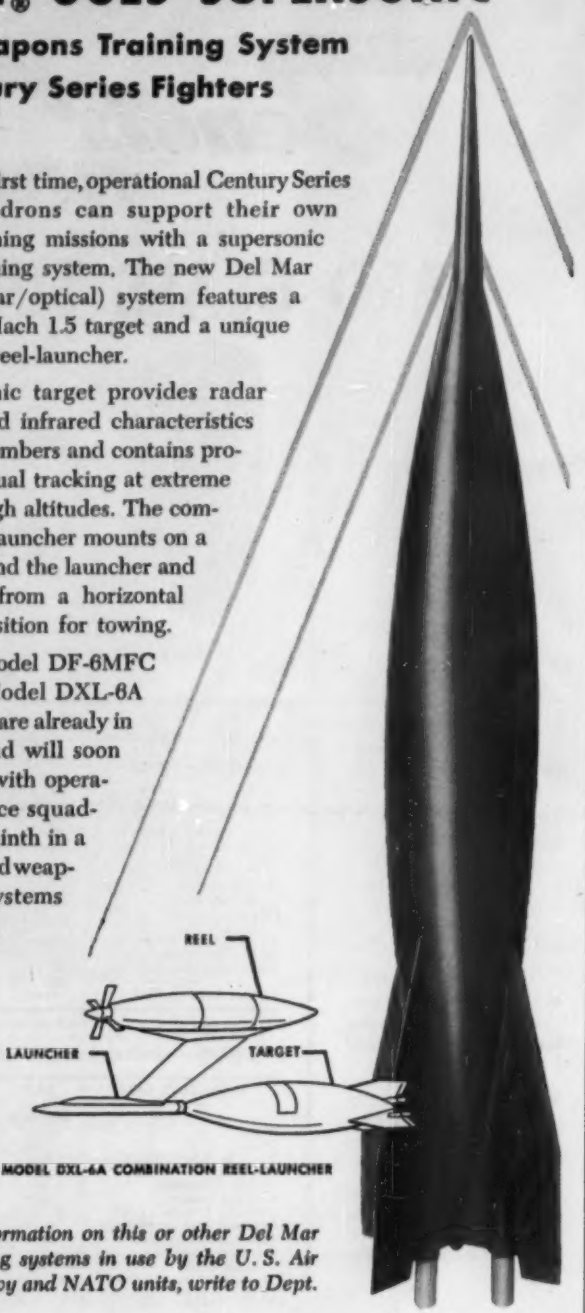
These new Model DF-6MFC targets and Model DXL-6A reel-launchers are already in production and will soon be in service with operational Air Force squadrons...as the ninth in a line of advanced weapons training systems from Del Mar.



MODEL DXL-6A COMBINATION REEL-LAUNCHER

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Del Mar ENGINEERING LABORATORIES

INTERNATIONAL AIRPORT • LOS ANGELES 45 • CALIFORNIA

AVIATION CALENDAR

(Continued from page 5)

posium, Airwork Corp., Millville, N. J.

Sept. 24-25—Ninth General Assembly, Advisory Group for Aeronautical Research and Development, NATO, Aachen, Germany. Subject: Space Research Techniques and Recent Experimental Data.

Sept. 28-30—1959 National Symposium on Telemetering. Civic Auditorium and Whitcomb Hotel, San Francisco, Calif. Sponsor: Institute of Radio Engineers' Professional Group on Space Electronics & Telemetry.

Sept. 30-Oct. 2—13th Annual Meeting, Southeastern Airport Managers' Assn., Washington Duke Hotel, Durham, N. C.

Oct. 1-3—23rd Annual Convention, International Northwest Aviation Council, Multnomah Hotel, Portland, Ore.

Oct. 5-7—Seventh Anglo-American Aeronautics Conference, Institute of the Aeronautical Sciences, Hotel Astor, New York.

Oct. 5-7—Fifth National Communications Symposium, Hotel Utica, Utica, N. Y. Sponsor: Institute of Radio Engineers' Professional Group on Communications Systems.

Oct. 5-10—National Aeronautic Meeting, Society of Automotive Engineers, the Ambassador, Los Angeles, Calif.

Oct. 6—12th Annual Airport Development & Operations Conference, Hotel Onondaga, Syracuse, N. Y. Sponsor: Bureau of Aviation, New York State Department of Commerce.

Oct. 6-8—12th Annual Meeting, National Business Aircraft Assn., Hotel Leamington, Minneapolis, Minn.

Oct. 6-8—Radio Interference Reduction and Electronic Compatibility Conference, Museum of Science and Industry, Chicago, Ill. Conducted by Armour Research Foundation in cooperation with Institute of Radio Engineers' Professional Group on Radio Frequency Interference. (Classified session on Oct. 8.)

Oct. 6-9—International Symposium on High-Temperature Technology, Asilomar Conference Grounds, Monetary Peninsula, Calif. Sponsor: Stanford Research Institute.

Oct. 7-8—Second Advanced Propulsion Systems Symposium, New England Mutual Hall, Boston, Mass. Sponsors: Air Force Office of Scientific Research; Avco-Everett Research Laboratory.

Oct. 7-10—Fourth Annual National Meeting, Air Traffic Control Assn., Biltmore Hotel, Oklahoma City, Okla.

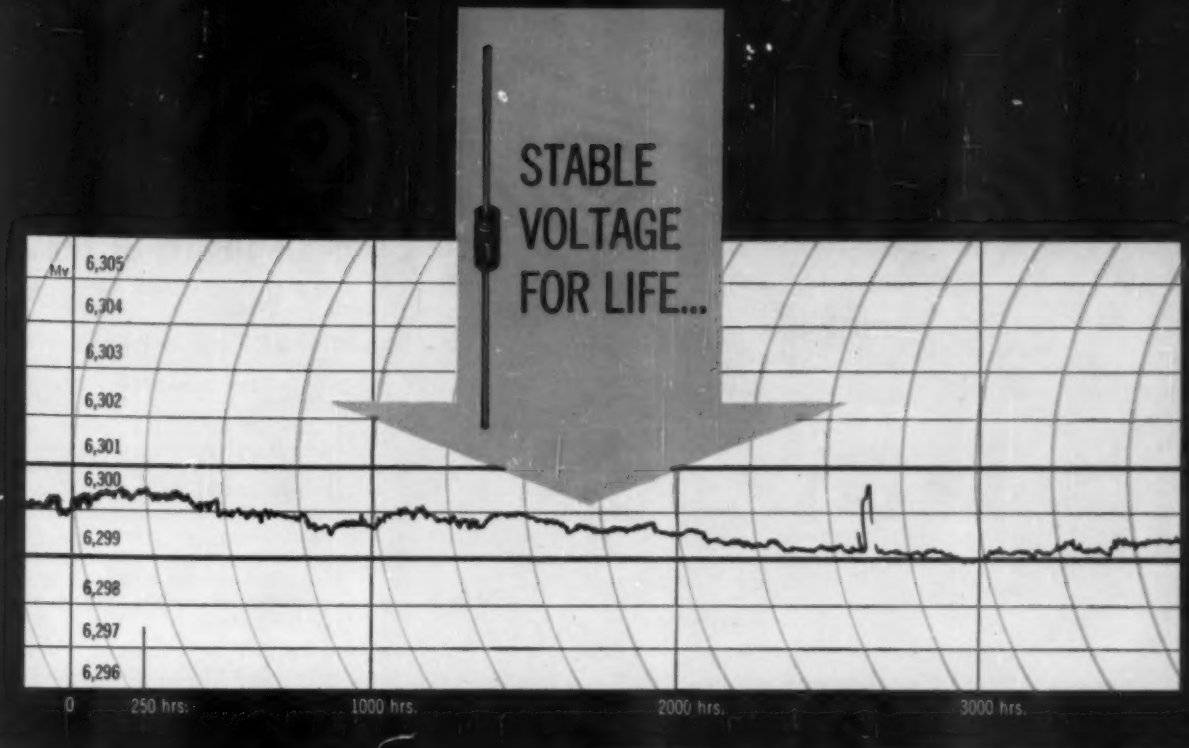
Oct. 8-10—Society of Experimental Test Pilots' Symposium on Pilot's Role in Space Exploration, Beverly Hilton Hotel, Beverly Hills, Calif. Third Annual Awards Banquet, Oct. 10.

Oct. 12-14—15th National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 12-16—15th Annual General Meeting of the International Air Transport Assn., Imperial Hotel, Tokyo, Japan.

Oct. 12-16—National Aeronautics and Space Administration's 1959 Inspection, Langley Research Center, Hampton, Va.

Oct. 14-23—"William Tell II" Seventh World-Wide Interceptor Weapons Meet, Tyndall AFB, Panama City, Fla. Host: Air Defense Command.



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Type	Voltage Range at I_Z = 7.5 ma at 25°C (Volts) Min.	Max.	Temp. Coefficient[2] (−55°C to +100°C) at I_Z = 7.5 ma (%/°C)	Maximum Dynamic[3] Resistance at 25°C at I_Z = 7.5 ma (ohms)	Operating and Storage Temperature Range (°C)	Max. Operating Temp. at I_Z = 7.5 ma (°C)
1N821	5.9	6.5	±.01	15	−65 to +150	+125
1N822[1]	±5.9	±6.5	±.01	15	−65 to +150	+125
1N823	5.9	6.5	±.005	15	−65 to +150	+125
1N824[1]	±5.9	±6.5	±.005	15	−65 to +150	+125
1N825	5.9	6.5	±.002	15	−65 to +150	+125
1N827	5.9	6.5	±.001	15	−65 to +150	+125

[1]Double anode types.
[2]Determined by measuring a change of voltage from −55°C to +25°C and a change of voltage from +25°C to +100°C.
[3]The Dynamic Resistance is measured by superimposing a small A.C. Signal upon the test D.C. Current. (I_{AC} RMS = 1/10 I_{DC} Test)

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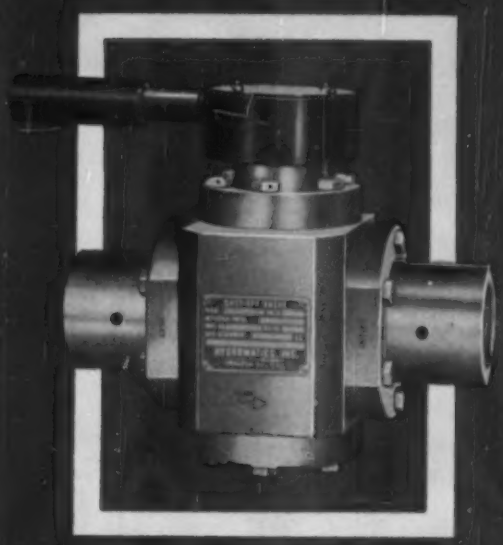

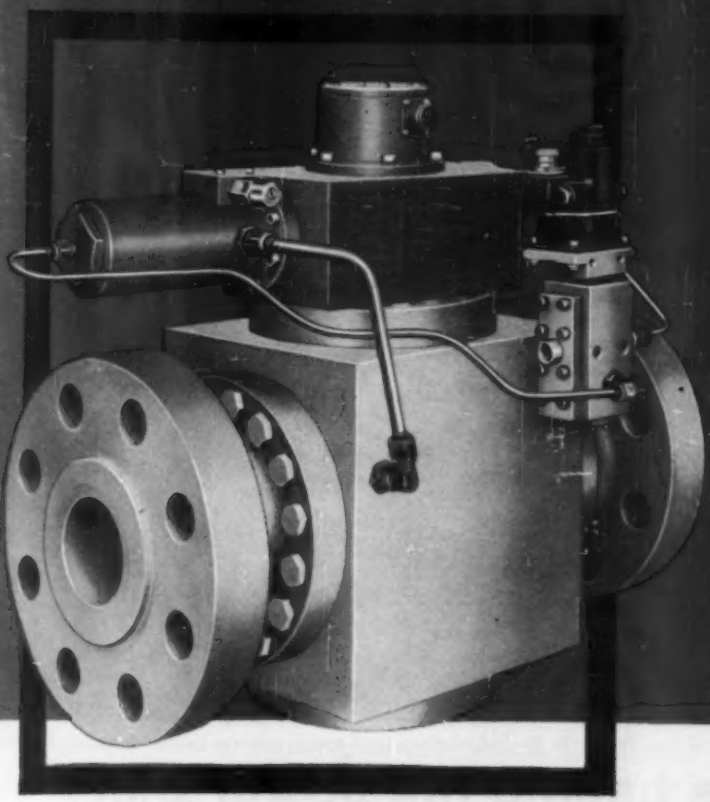

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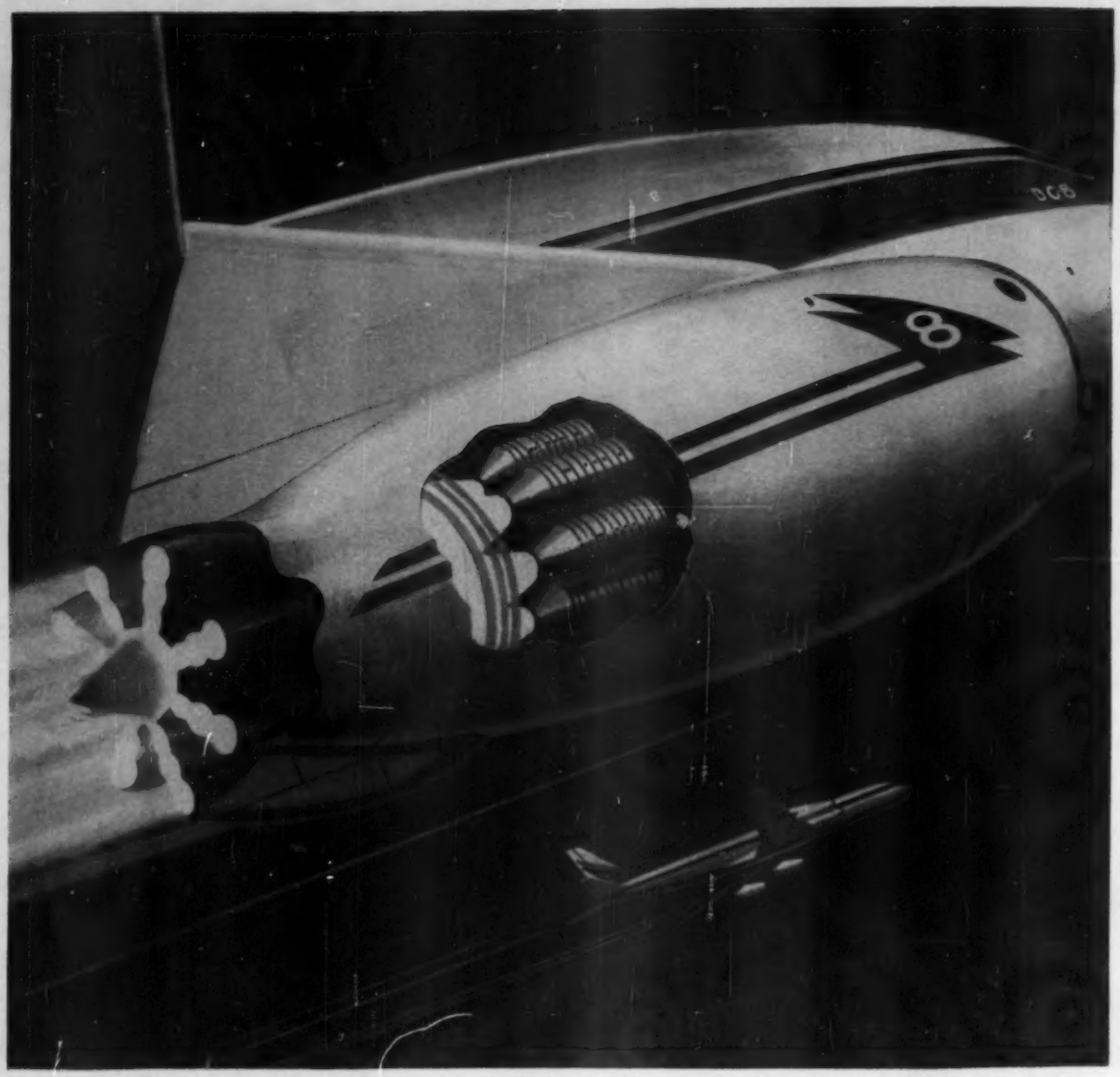

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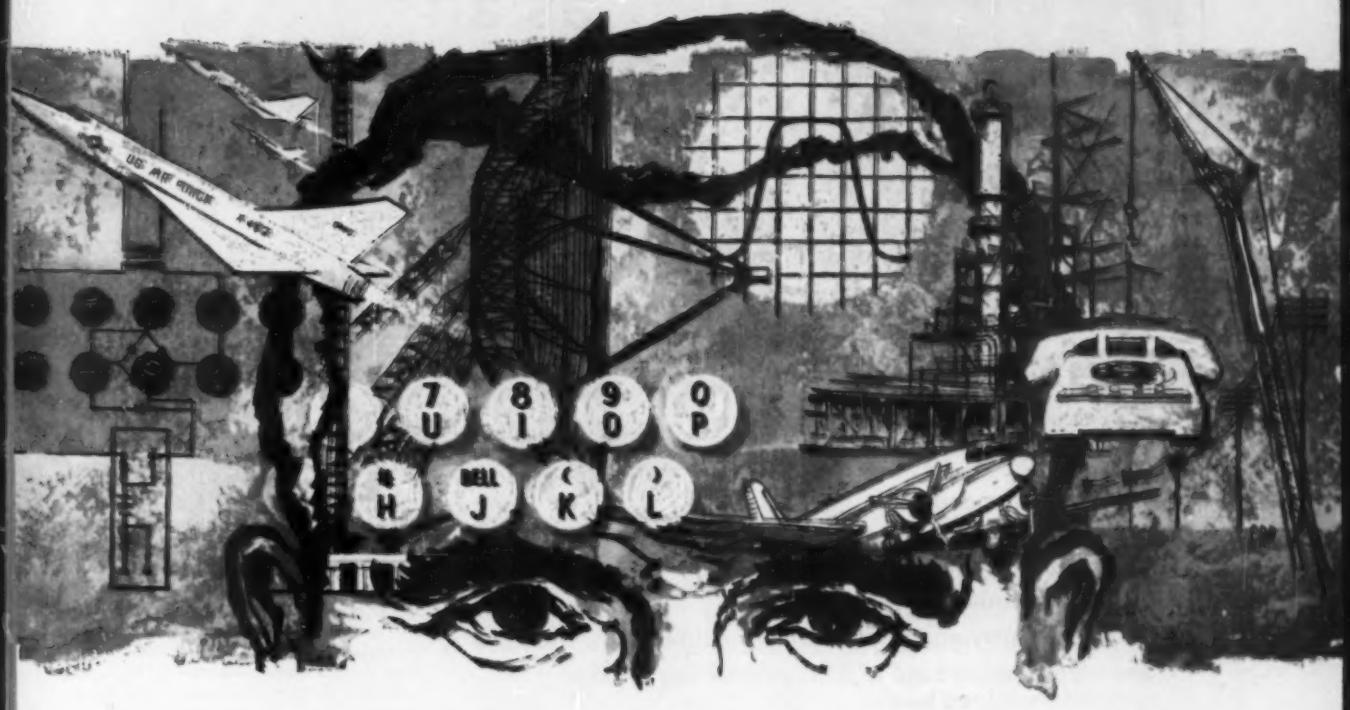

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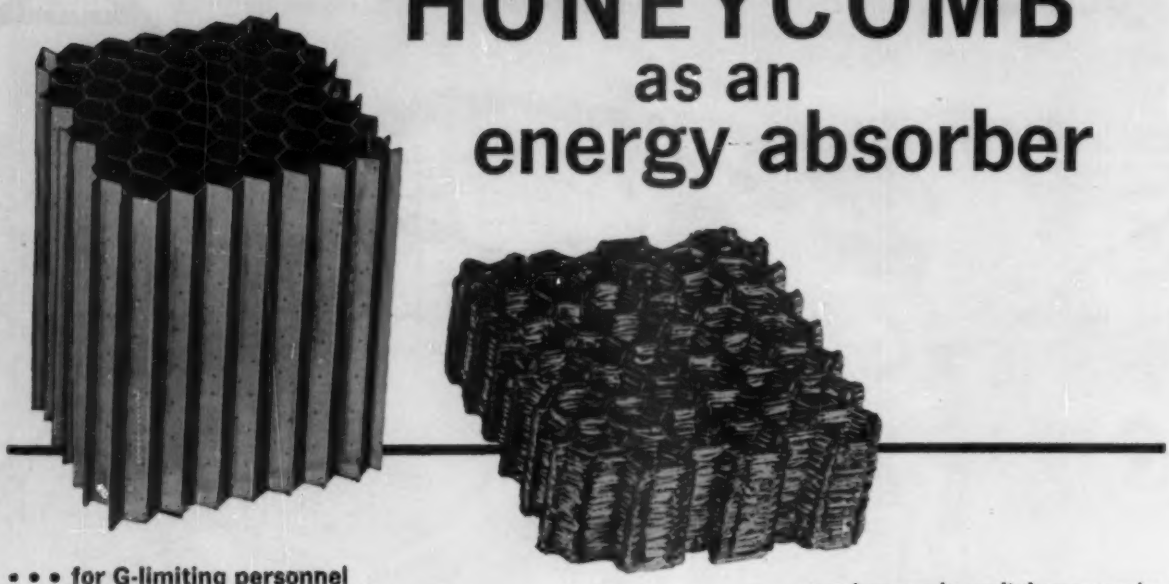
HONEYCOMB as an energy absorber



- • • for G-limiting personnel protection devices
- • • for protecting air-dropped supplies
- • • for impact limiting safety linkages
- • • for missile instrument recovery assemblies
- • • and other applications to limit destructive G-loads to pre-determined levels

While honeycomb materials are used principally in light-weight, high-strength sandwich structures, increasing emphasis has been placed on the use of honeycomb to control forces exerted on decelerating objects. Such control is highly desirable in cushioning the impact of air-dropped supplies, protecting instrumented missile assemblies, providing impact-limiting linkages in landing gear structures, packaging fragile items, and protecting human occupants of high speed vehicles.

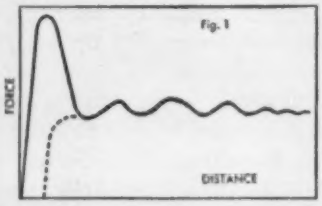
The Problem

Instances requiring impact energy absorption are generally typified by low tolerable deceleration rates for the structure or its contents, high impact velocities, and small maximum allowable stopping distances. Such absorbers as mechanical springs, sponge or solid rubber, foams, cork, and wadding generally exhibit spring characteristics, in that the force transmitted through these absorbers to the object being stopped increases continuously through the distance in which the absorbers contract. In addition, many of these materials do not absorb energy, but merely store it for release as rebound energy.

If an absorber could exert a relatively constant non-rebound force throughout the entire stopping distance, that distance could be shortened, or alternately, the maximum force acting on the object in the same stopping distance could be materially reduced.

Advantages of Honeycomb

Honeycomb core materials tend to follow such a constant force curve, as shown in Figure 1.



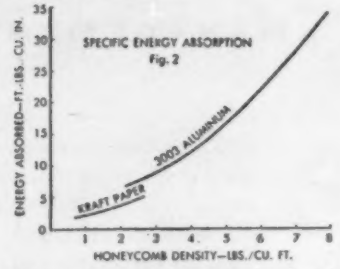
The initial peak on the curve represents the point at which compressive failure begins. This peak can be lowered by prestressing the core to produce slight initial compressive failure. When subjected to further or subsequent loading, the prestressed core proceeds immediately to carry the crushing load, as shown by the dashed line curve in Figure 1.

The main illustration shows the appearance of aluminum honeycomb core before and after compressive failure.

By designing a honeycomb core assembly with a specified cell depth this constant force can be applied over a predetermined stopping distance.

Available Materials

These principles apply to aluminum and paper honeycomb, and most similar honeycomb core materials fabricated from ductile metals and fabrics. Figure 2 indicates the general range of energy absorption capacity available in aluminum and paper materials.



These capacities can be further increased by filling the cells with various foamed materials. Detailed information is available to assist the designer in the specific selection of a core material for exact requirements.

Optimum Solution

The choice of materials by the designer will depend upon the particular requirements of the application. But it seems apparent that the utilization of honeycomb offers the optimum solution—in terms of weight and volumetric efficiency—to many types of energy absorption problems.

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The General Electric Heat Rate Computer, another G-E custom design, simulates aerodynamic heating encountered by high-speed aircraft in flight. One system has been installed at a test center; another is under test.

This product typifies the engineering and manufacturing capabilities at General Electric's Computer Department. From receipt of the contract until acceptance by the customer, the systems are supervised by engineers and logicians with extensive backgrounds in computer design, development, and manufacture. To provide greater efficiency and economy, transistorized modular electronic components are used throughout.

If you are contemplating custom-designed or R & D projects in the areas of data handling, data acquisition, or simulation systems, please contact: Computer Department, Room 660, General Electric Company • Deer Valley Park • Phoenix, Arizona

Progress Is Our Most Important Product

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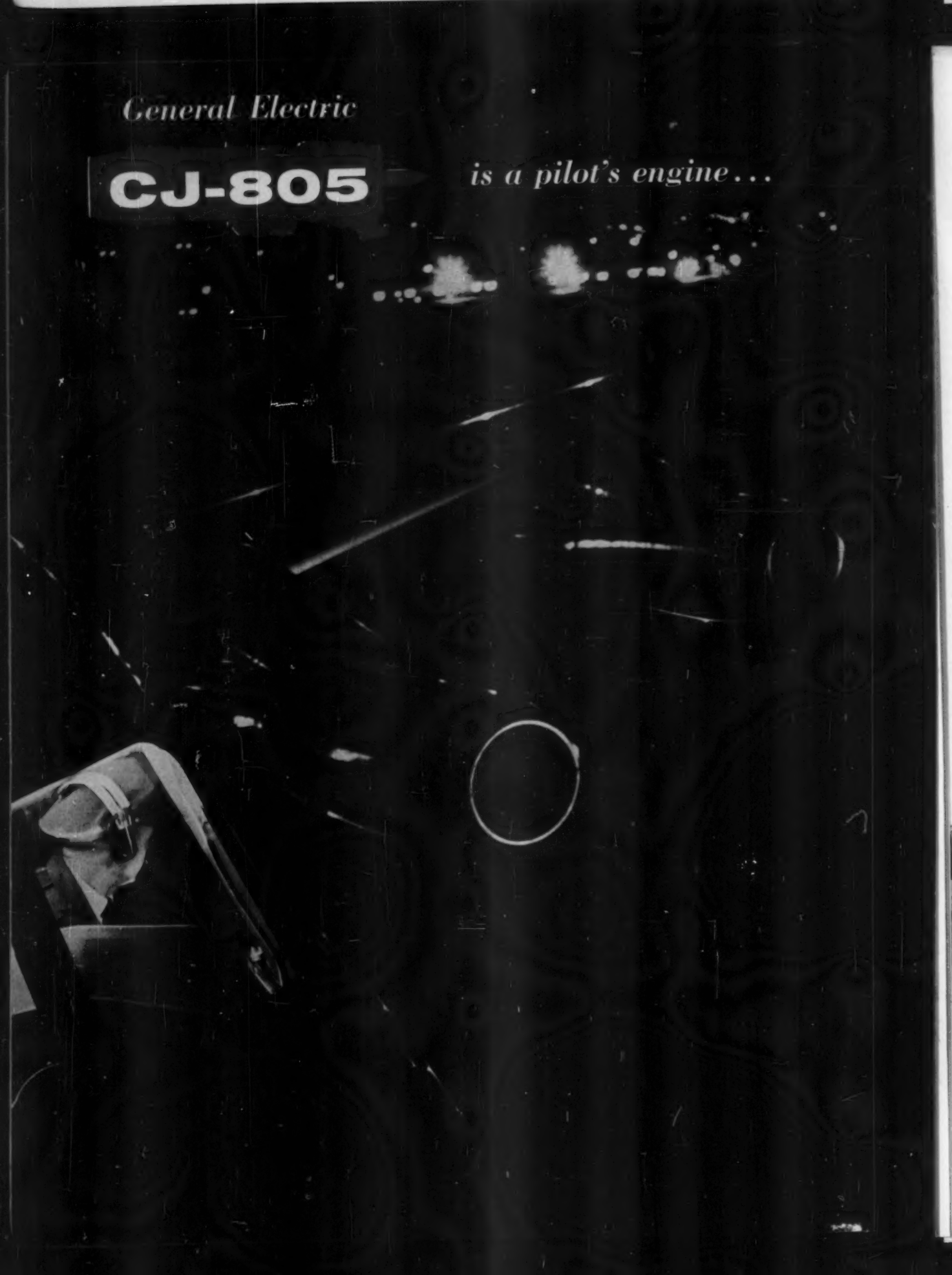
FOR FIGURES IN A HURRY—FIGURE ON A GE COMPUTER

GEA-173-60


General Electric
CJ-805
is a pilot's engine...

reliable, responsive, and mature

Look at the General Electric CJ-805 from the pilot's viewpoint.

CJ-805 Reliability—Throughout thousands of hours of "squawk-free" operation, CJ-805s are showing their ability to meet pilot requirements—in timely starting, fast full power for take-off, prompt response to throttle changes during landing approach and reverse thrust operation.

CJ-805 Response—In an emergency aircraft "wave off" during landing, CJ-805s are less than three seconds away from full power. From ground idle to take-off throttle settings the engine produces full power in less than 6 seconds. Throttle bursts, chops, in-flight shutdowns and restarts have been consistently accomplished without difficulty in the Convair 880s, G.E.'s leased B-66 and XF4D to extreme altitudes.

CJ-805 Maturity—CJ-805 production engines, identical to those flying on CV-880s, have already demonstrated ruggedness and maturity in thousands of flight and factory test hours. Two engines have completed 2000-hour ground tests—one of these is now flying in G.E.'s leased B-66, approaching 3000 hours total time. Pilots flying CJ-805 powered aircraft will have an engine whose design and operating maturity have been fully proven.

From the pilot's viewpoint, or any other, CJ-805 power makes good sense. For more information, contact your G-E Aviation and Defense Industries sales representative or *General Electric Company, Cincinnati 15, Ohio.* 237-28

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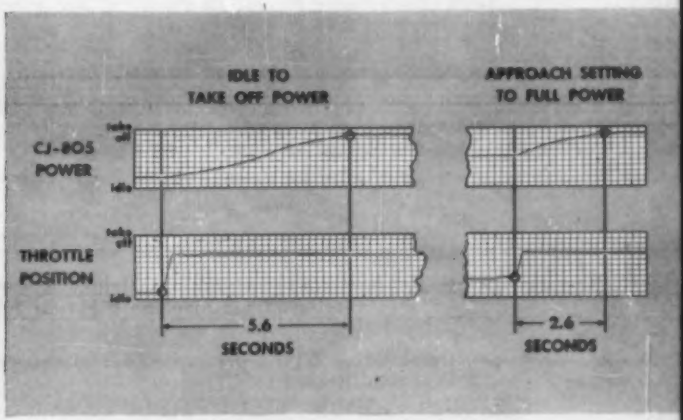
CONVAIR FLIGHT TEST PILOTS flying 880 evaluations are Don Germeraad (left) and Phil Prophett. Observed Germeraad, ". . . The G-E CJ-805 proved to me that it has power when you need it." From their point of view, the CJ-805 is a pilot's engine.



FAST RESPONSE TO THROTTLE takes CJ-805 fan engine from idle to take-off power in 5.6 seconds and from approach settings (20% power) to full power in 2.6 seconds. Brush tracings of an actual CJ-805 run document immediate, dependable response.

FLIGHT TEST REPORT ON THE BELL XV-3

THE REVOLUTIONARY BELL XV-3 is the convertiplane that's surpassing expectations. Developed for the U.S. Army as part of the military's over-all VTOL program, the XV-3 has moved well beyond Bell's extensive shakedown tests . . . has successfully completed a thorough Phase II Air Force evaluation at Edwards AFB.

Demonstrated capabilities to date include—

- Over 60 full conversions in all flight regimes, including climbing turns and descents, full and partial power.
- More than 25 gear shifts proving out smooth, high-efficiency cruise flight.
- All normal airplane maneuvers, including slips, stalls, pull-ups and rolls.
- Basic emergency procedures, including power-off reconversions from airplane flight to full autorotation helicopter landings.
- Outstanding STOL performance under overload conditions.

The XV-3 was ready on time for all the 33 scheduled tests of the six-week USAF program. This dependability, plus the technical data obtained, show without question that the XV-3 has solved VTOL's central problem — that of combining vertical, low-speed capabilities of the helicopter with long-range, high-speed advantages of the airplane in a reliable, serviceable machine.

The XV-3's fixed-wing, low disc loading configuration inherently provides higher hovering efficiencies, lower downwash velocities than other VTOL types. Now, recent tests have also confirmed superior stability and controllability in all flight regimes, higher efficiencies in airplane cruise.

Now shown to be technically and operationally practical, the XV-3 concept is ready for advanced military VTOL/STOL systems.

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And this new Cambridge Management Team:

C. N. Rees—General Manager: Formerly with Stone & Webster and V. P. of sales at Southwestern Engineering Co., Los Angeles; now executive vice president of Standard Steel.

David A. Williams—Director of Engineering: M. E. Ohio State University. Formerly with cryogenic laboratory, Ohio State University; research and development engineer, Linde Air Products; Engineer, National Cylinder Gas Company.

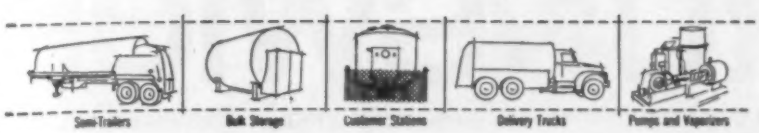
Charles R. Rinehimer—Manager of Manufacturing: Degrees in physics from Western Maryland College. Formerly plant manager of company manufacturing processing equipment for liquid gases.

Donald Jensen—Assistant General Manager: Many years with Standard Steel Corporation as chief draftsman, test engineer, quality control manager, project engineer and now assistant chief engineer.

Robert F. O'Neill—Quality Control Manager: M. E. University of Massachusetts. Formerly design and project engineer with Process Engineering, Inc. Since 1952 with Cambridge Company in various engineering capacities.

George E. Toerge—Comptroller: Formerly assistant treasurer of Blaw-Know Company, Pittsburgh; now treasurer of Standard Steel Corporation, Los Angeles.

STANDARD STEEL CORPORATION



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Leader Iron Works
(Division)
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Cambridge Company
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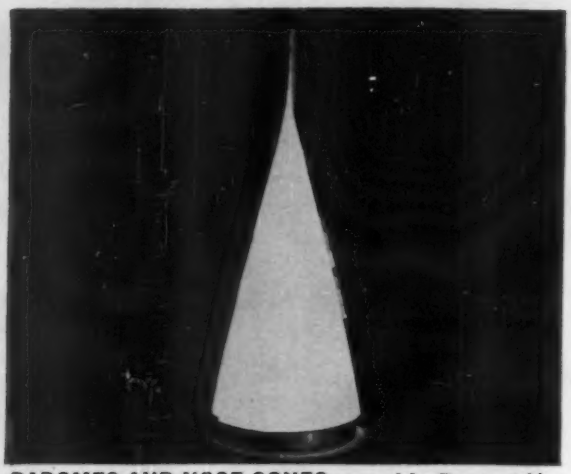
Lowell, Massachusetts

Brunswick technology leads the way in three critical space-age components

PRESSURE VESSELS AND MOTOR CASES, fabricated by Brunswick's exclusive Strickland "B" Process, now have the highest strength-to-weight ratio ever obtained in filament-wound components. Brunswick is *now* producing these virtually leak-proof pressure vessels. Brunswick also fabricates motor cases capable of withstanding extremely high pressures and temperatures.



RADOMES AND NOSE CONES, created by Brunswick's outstanding research and development efforts and filament winding process, are being used on supersonic aircraft such as the advanced Convair F-106 and McDonnell F4H, as well as on missiles such as the Boeing Bomarc, Lockheed Q5 and similar missiles. And, of course, Brunswick capabilities include complete electronic design and test facilities.

HONEYCOMB ASSEMBLIES, now developed by Brunswick can support two million times their own weight. Brunswick research has created honeycomb assemblies of paper, fiber glass, aluminum and stainless steel as well as conventional forms. Using the most advanced adhesive systems, these assemblies can be formed in compound curvatures with extremely close tolerances.

RESEARCH, DEVELOPMENT AND TESTING—carried on by Brunswick teams have contributed heavily to space-age technology . . . most notably in solving problems of increasingly high operating temperatures (600°—4,000°F.) for critical components and new heights in strength-to-weight ratios. For full information on how this leadership can help you, write or call Brunswick today!

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August 31, 1959

Aviation Week
Including Space Technology

Vol. 71, No. 9
Member ABP and ABC

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Glennan Raps 'Exotic' Space Predictions 26
► NASA administrator warns against rapid advances in multi-project programs without manpower, funds.

Turbojet DH-121 Designed for Economy on Short Hauls 40
► De Havilland claims its 75-97-passenger three-jet airliner has 10% seat-mile cost advantage.

Cessna 210 Design Changes Add Speed, Controllability 98
► Retractable landing gear, swept vertical stabilizer mark major changes to fill gap between Skylane and Model 310-C.

SPACE TECHNOLOGY
Glennan Raps 'Exotic' Space Forecasts 26
Canaveral Complex—Part II 54
NASA to Receive Scout in Month 31
Little Joe Test Aborted 33
High-Thrust Complex Construction ... 65

MISSILE ENGINEERING
Atlas Nears Operational Status 27
How Minuteman Releases Warhead .. 39
Tower Services Jupiter, Redstone 93

AERONAUTICAL ENGINEERING
X-15 Glide Tests 88
Soviets Comment on B-70 28
Turboprop Installed in CL-44 30

AVIONICS
DEW Line Proves Effectiveness 66
Radio Telescope Construction Delayed 32
Alaskan Stations Track Discoverer ... 74
Diode Heat Limits Raised 80
Expansions, Changes 80
Filter Center 81

EQUIPMENT
JetStar Interior Mockup 86
Mach 3 Aircraft Canopy Material 92
New Aviation Products 94
What's New 95
DC-8 Baggage System 97

SAFETY
Instructor Blamed; Hector Dissents .. 117

AIR TRANSPORT
DH-121 Designed for Economy 40
707 Record Tops Piston Transports .. 45
Monroney Urges MATS Policy Changes 49
Japan Drops 707 Plan 49
Moscow's Third Commercial Airport .. 47
PanAm Begins 707 Polar Flights 50
Shortlines 51
Airline Observer 51
Airline Income & Expenses 53

BUSINESS FLYING
Cessna 210 Pilot Report 98
U. S. Business Aircraft Shipments ... 111
Twin Bonanza Gets JATO 113

MANAGEMENT
U. S. Urges Better Measuring Standards 28
Defense Ban of Gen. Power Book 29
Navy Cancels P6M Production 32
GAO Charges F-102 Overpriced 31
Boron Cancellation Explained 30
Who's Where 23
Industry Observer 23
Washington Roundup 25
News Digest 39
Navy Contracts 90
AMC Contracts 92

Calendar 5
Letters 138

Message From The Publisher
Expansion for 1960 21

COVER: Family resemblance between the new Cessna 210 and the Cessna line of single engine airplanes is visible in this flight view, with exception of vertical stabilizer, retracted landing gear and sharp downturn at wingtips. Aircraft, standardly equipped, will sell for $22,450. For Aviation Week pilot report, see p. 98.

PICTURE CREDITS

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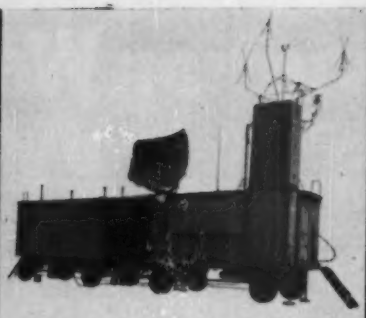
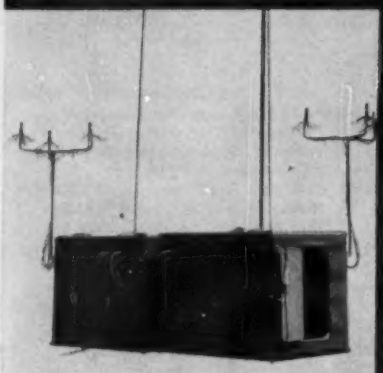
78,085 copies of this issue printed

1. RADAR TARGET SIMULATOR. Radar Trainer **AN/GPH-T2** provides 3-dimensional, realistic aircraft targets on any radar scope. Subminiaturization puts electromechanical servos, 200 vacuum tubes all in one 30-inch console.



2. GROUND CONTROLLED APPROACH RADAR SYSTEM AN/MPN-11 for air safety, is contained in two ground- and air-transportable vehicles. It provides a completely self-contained navigation aid that operates worldwide.

3. PORTABLE MAINTENANCE JUNCTION BOX allows functional equipment groups of complex radar sets to be interconnected on a maintenance bench. The mobile box provides accurate testing for comprehensive subsystems.



4. COMPLETE TACTICAL AIR TRAFFIC CONTROL CENTER AN/TSQ-18 is reduced in size and weight to three packages for helicopter transport. The system functions in all weather at forward air strips and in terminal areas.

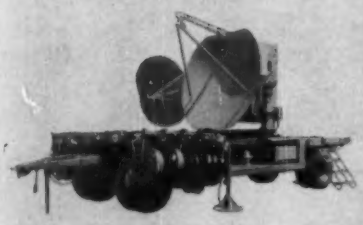
GILFILLAN/1959

8 MORE WAYS GILFILLAN PROVES ITS ELECTRONIC SYSTEMS CAPABILITY LEADERSHIP

Today Gilfillan's capability is at its greatest peak in the Company's 47-year history. Shown here are 8 Gilfillan achievements representing successful know-how in the development and production of complete electronic systems.

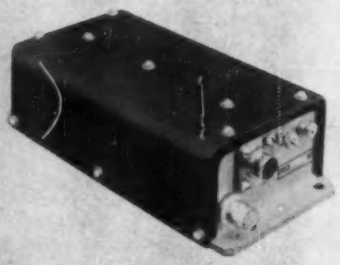
These 8 examples and many others have been and are in operational use by military and civilian agencies in 38 countries throughout the world.

5. LIGHTWEIGHT GCA RADAR SET, QUADRADAR, AN/FPN-33 is a highly mobile surveillance, approach, landing and taxi system that has achieved an enviable world-wide record of operation with both military and civilian users.



6. GROUND-BASED COUNTERMEASURES AN/MLQ-7 is a ground jammer for use against airborne bombing radars. Equipment supplies broad frequency coverage, rapid reaction capability with advantages of semi-automatic operation.

7. RADAR-TRACKER INTERROGATOR OA-1333/MSW-2 with radome (portion of an all-weather system). Developed for Corporal System as a low-priced, high-accuracy and -performance radar, uses can now include range instrumentation.



8. FM-FM TELEMETRY TRANSMITTER 86600 operates in VHF frequency spectrum of 215-235 and 235-260 megacycles. High-reliability, small size transmitters meet all IRIG requirements, including rejection of spurious responses.

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Message From the Publisher

Expansion for 1960

As the aviation industry and its related technologies head toward the final quarter of 1959 it is evident that the technical, financial and government policy changes that have been altering its character and enlarging its scope during the past five years will continue to ferment and provide the industry with major challenges in the future.

Within this framework of change and ferment, there will remain a solid defense market plus a growing air transport market. The Fiscal 1960 Defense Department budget recently signed into law by President Eisenhower (AW Aug. 10, p. 26) specifies $10.2 billion in new procurement of aircraft, missiles and avionic equipment plus a $3.6 billion research and development budget for the three military services and the Advanced Research Projects Agency. The National Aeronautics and Space Administration also was authorized a Fiscal 1960 budget of $500 million. The air transport industry, with its new turbojet and turboprop transports leading the way, appears to be heading for a new record in net income (AW Aug. 24, p. 41).

To continue to provide the fast, accurate communications required by this ever-changing industry, AVIATION WEEK will expand its editorial, sales and circulation programs during 1960. During the first six months of 1959, AVIATION WEEK established new peaks of leadership in editorial coverage, advertising volume and paid circulation.

Editorial Advances

Among the significant editorial achievements during the first half of 1959 were:

• **Publication of the 216 page Air Transport issue** on May 4 with the first detailed operational reports on jet transports in airline service and the Air Transport Assn.'s annual statistical report.

• **Publication of the 344-page Space Research issue** on June 24, including a special report on the NASA programs and goals for the next decade. Including special orders of reprints for NASA, the Air Force Command and Staff College, research agencies in the Pentagon and the U.S. Information Service, more than 100,000 copies of this special report on NASA were distributed.

• **Increased international coverage of the air transport industry,** including a series from Russia on the expansion of Aeroflot, the Soviet airline, into the jet age; detailed technical coverage of initial operational problems of the Boeing 707 and Lockheed Electra, and a series of flight test evaluations by AVIATION WEEK editor-pilots of military and civil transports such as the Douglas C-133, the de Havilland Comet 4 and Vickers Vanguard continuing the series begun last year on the Boeing 707, Fairchild F-27 and Lockheed Electra.

• **Increased coverage of avionics' radical new technical developments** plus the growing complexities of the air defense problem, including on-the-spot reporting from the DEW line by Avionics editor Phil Klass.

As an example of the far-flung editorial coverage of AVIATION WEEK, during the next 60 days its staff members will provide on-the-spot coverage of the International Astronautics Federation Conference in London, the annual SBAC flying display at Farnborough, the international airline fare conference in Honolulu and the International Air Transport Assn. general meeting in Tokyo.

AVIATION WEEK has pioneered this editorial technique of providing on-the-spot coverage from key events and industry centers by staff members seasoned with both editorial and technical experience and using the fastest communications methods to deliver this information to the industry while it is still vital to the conduct of its business. During 1960, this 34-man editorial staff will be expanded in this country, Europe and Asia to provide the additional coverage the industry requires.

This unchallenged editorial leadership of AVIATION WEEK in its field has resulted in an all-time circulation peak of 74,750 net paid as of Aug. 1, with unabated top-level industry demand for this editorial product requiring a further increase to more than 80,000 during 1960.

Advertising Records

This combination of editorial leadership and high quality circulation has resulted in an outstanding advertising record during 1959. For the first six months of this year, AVIATION WEEK showed a gain of 359 pages, the largest in the field. During the first six months of 1959, AVIATION WEEK ran a total of 2,273 pages of advertising compared with 1,092 pages for Space/Aeronautics; 765 pages for Missiles & Rockets; 259 pages for Airlift and 194 pages for Aircraft and Missile Manufacturing magazine.

This trend continued in July when AVIATION WEEK gained 63 pages and in August when a gain of 177 pages was recorded—one of the largest for any single month in our history. For the first eight months of 1959, AVIATION WEEK advertising totaled 3,003 pages for a gain of 599 pages over the same period in 1958. During these eight months AVIATION WEEK attracted 148 new advertisers. Once again, AVIATION WEEK ranked among the top 10 business publications, based on advertising pages for the first six months of 1959, a distinction no other publication in our field has ever achieved.

It has been the cardinal principal of AVIATION WEEK's publishing philosophy to do whatever is necessary to provide the industry we serve with the vital information it requires for its operations. This information must be technically sophisticated, as accurate as is humanly possible and must be transmitted to subscribers with maximum speed.

This requires the same dynamics the industry needs to meet the ever-changing challenge of the future. Consequently, AVIATION WEEK's 1960 editorial, circulation and advertising programs will be designed to meet the industry's requirements in this era of swift technical change.

—Robert W. Martin, Jr.

SYMBOL OF QUALITY IN AIRCRAFT CONVERSION

The outstanding symbol of quality in aircraft conversion and modification, AiResearch Aviation Service employs more than 500 of the most highly trained and experienced engineers, technicians and craftsmen in the industry.

The most complete facility of its kind, including more than 100,000 square feet of floor space under one roof, AiResearch has converted more planes into executive aircraft and luxury airliners than any other company. That's why those who cannot afford anything but the best choose AiResearch.

Typical of the finest in custom interiors created through quality engineering at AiResearch Aviation Service is this Convair 340 executive aircraft.

BEAUTY · PERFORMANCE · DURABILITY · SAFETY · RELIABILITY

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In the Front Office

Zambry P. Giddens, executive vice president, Dynamics Corporation of America, New York, N. Y.

Harold A. Wheeler, a vice president and director, Hazeltine Corp., Little Neck, N. Y. Mr. Wheeler is president of Wheeler Laboratories, Inc., recently acquired subsidiary of Hazeltine Corp.

Col. Frank E. Oliver, Chief, Pricing Division, Directorate of Contract Support, Air Materiel Command's Aeronautical Systems Center, Wright-Patterson AFB, Ohio.

David T. Kimball, vice president and general manager, Whittaker Gyro Division of Telecomputing Corp., Van Nuys, Calif.

A. Charles Emanuel, vice president-director of manufacturing, and **Frank Garbis**, vice president-director of engineering, Woonsocket, R. I., facility of General Transistor Corp., Jamaica, N. Y.

Gerald E. Campbell, vice president-manufacturing, United Aircraft Products, Inc., Dayton, Ohio.

Richard I. Kern, vice president-marketing, Miniature Precision Bearings, Inc., Keene, N. H.

Frederick A. Twomey, vice president, Royal Industries, Inc., Los Angeles, Calif.

Victor Gehrig and **Robert A. Lehman**, senior vice presidents, Monogram Precision Industries, Inc., Culver City, Calif.

Ernst G. Heeren, vice president, Permatex Company, Inc., Huntington, N. Y. **Edgar C. Taelman** succeeds Mr. Heeren as managing director.

Robert Sheldon, vice president-engineering, and **Robert Hamerschlag**, vice president-sales, Kahn and Company, Inc., Hartford, Conn.

E. S. Twining, Jr., vice president-marketing, Air Reduction Sales Co., a division of Air Reduction Company, Inc., New York, N. Y.

Sam D. Cooper, a vice president, Rutherford Electronics Co., Culver City, Calif.

Everitt A. Carter, president, Oak Mfg. Co., Chicago, Ill., succeeding **Robert A. O'Reilly**, now board vice chairman and chairman of the executive committee.

Dr. Charles E. Duke, vice president-research and development, and **Philip J. Freed**, vice president, HRB-Singer, Inc., State College, Pa. **Dr. Charles R. Ammerman** succeeds Dr. Duke as head of the research department.

Honors and Elections

Gwilym A. Price, board chairman of Westinghouse Electric Corp., has been named 1960 recipient of the John Fritz Medal for ". . . marshalling the creative forces of research and engineering to the cause of developing atomic power for the national defense and for the human welfare."

C. W. Weinert, group administrator for Radioplane Division of Northrop Corp.'s facility at the Air Force Missile Test Center, Holloman AFB, N. M., has been elected chairman of the Executive Committee of the Holloman Test Directors Council.

(*Continued on page 116*)

INDUSTRY OBSERVER

► Watch for Advanced Research Projects Agency to begin to transfer some of its space programs to individual military services. First transfers probably will involve the ARPA communication satellites, with delayed-relay courier and 24-hr. hovering types going to Army and the polar-orbit real-time repeater assigned to Air Force.

► **Final decision on contractors for ARPA's polar-orbit communications satellite is expected to be made within a month. Source selection board recommendation was made to ARPA on Aug. 19. Approximately 24 contractors submitted proposals in the competition.**

► Defense Department is expected to shift farther and farther away from weapon-system-type procurement in its space programs, making increased use of separate contractors for the rocket booster and the satellite space vehicle payload. Reason for the shift is that integration of payload with earth-based tracking and communications equipment with which it must operate is considered more critical than integration of payload and launching vehicle.

► **Top Air Force group also is taking a critical look at the complete weapon system management picture to determine how it fits in with new USAF efficiency and economy goals.**

► National Aeronautics and Space Administration's Able IV vehicle boosted by an Air Force-Convair Atlas ICBM is scheduled to make a lunar orbit attempt from USAF Missile Test Center, Cape Canaveral, Fla., on Oct. 3. Able IV, a key shot in the Able probe series, is designed to provide data substantially in excess of that obtained with Explorer VI which has a highly elliptical orbit.

► **First in a series of 30 high-altitude drops of the capsule mockup for NASA's Project Mercury to test out its parachute landing system designed by Northrop's Radioplane Division (AW Aug. 24, p. 28) was recently made from a Lockheed C-130 at an altitude of 30,000 ft. over California's Salton Sea. Capsule was retrieved with a photographic record of what appeared to be perfect chute action during descent.**

► Defense Department is not likely to approve the launching of a development program for a third-generation ballistic missile to supersede the Minuteman for several years at least, according to a top Defense official. Department will, however, continue to push development of improved rocket engines, guidance and re-entry bodies which might find use in a third-generation ballistic missile.

► **Air Materiel Command's Ballistic Missile Center will soon inaugurate a new internal organizational plan intended to streamline the agency's participation in the over-all efforts of Air Research and Development command and AMC in the ballistic missile field. A similar reorganization is planned by ARDC (AW Aug. 17, p. 25).**

► Aside from fiscal reasons, one major point behind Air Force and Navy decision to abandon production of high-energy chemical fuels for aircraft (AW Aug. 17, p. 26) is their high neuro-toxic effects on personnel engaged in their manufacture and use.

► **Army evaluation of Radioplane's zero-launch recoverable RP-77D target drone powered by a Boeing 502-10F turboprop is scheduled for completion by the end of September. More than 50 flights have been conducted at Fort Bliss and White Sands. During flight trials, the drone has attained 367 kt. at 40,000 ft., 374 kt. at 30,000 ft. Top altitude has been 46,500 ft. Time on station of 94 min. has been attained at altitudes above 40,000 ft., with the drone maintaining a speed in excess of 300 kt. About seven flights per drone have been averaged in the research and development program.**

► Outline of services Boeing expects to perform in assembly and test and ground support aspects of Minuteman ICBM has been presented to ARDC's Ballistic Missile Division, AMC's Ballistic Missile Center and Space Technology Laboratories.

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Washington Roundup

York Views Nike Zeus

Proponents of Army's Nike Zeus have failed thus far in attempts to convince Dr. Herbert York, director of Defense Research and Engineering, that the missile is a practical solution to the ballistic missile defense problem. Cost of implementing Nike Zeus on a scale sufficient to protect major military bases and urban centers would be "many tens of billions of dollars," York believes. The Defense Department official believes that manned aircraft will continue to play an important role in air defense, possibly against missiles, but feels that ballistic missiles will play the major role in strategic bombardment. Speaking at the recent Western Electronic Convention in San Francisco, York criticized the military services for their preoccupation with large missile and space programs, while neglecting much-needed small tactical missile and anti-submarine warfare programs.

Durfee Court Nomination

Civil Aeronautics Board Chairman James R. Durfee was nominated by President Eisenhower last week to the U.S. Court of Claims. The nomination, first predicted by 'Aviation Week (AW Mar. 16, p. 25), has been sent to the Senate, but it is quite possible that it will not be acted upon before Congress adjourns, probably Sept. 15. If the nomination fails to reach the Senate floor before adjournment, the White House can give Durfee a recess appointment to move to the Court this fall. A successor to Durfee has not been named.

Contractor Parties

Air Force is warning its officers to decline contractor entertainment in the wake of congressional criticism. Discussing weekend entertainment of defense officials by the Martin Co. at the Eleuthera Club in the Bahamas, Philip B. Taylor, USAF Assistant Secretary for Materiel, said "the inference can be drawn that the entertainment was improper. Whether or not it actually was is beside the point." Such restrictions had been proposed earlier by the House Armed Services Subcommittee (AW Aug. 24, p. 33).

Controversial "off-the-record" party planned, and later canceled, by a group of aircraft industry officials for Lt. Gen. Bernard Schriever, new commander of Air Research and Development Command, also was discussed with the subcommittee. Taylor said it would be "very improper" if the party were actually off the record. He said he doubted if Schriever would participate in such an affair, commenting "he isn't the type." Taylor approved social discussion of "public" Air Force business with contractors.

Subcontractor Complaints

Senate Small Business Committee has presented these complaints against prime contractors by small business defense subcontractors in a report to the Senate:

• **Prime contractors are presenting** inaccurate subcontract costs to the government, as shown by reports of the General Accounting Office (see p. 34). "Some of these reports allege all the elements of fraudulent activity on the part of certain prime contractors."

• **Prime contractors do not always** pass on to subcontractors the interim financing they receive from the military services. The rule of thumb that General Electric Co. follows, for example, is that, in order to obtain progress payments, the subcontract must amount to over $500,000 and run for at least six months.

• **"In one form or another,** the large prime contractors are 'proselytizing' the small firms' technical information and know-how. In some instances . . . the prime made no pretense about the fact that he was seeking, through channels of subcontractor bid solicitations, further information for his own in-plant use."

• **Large weapon-system contractors** "have too often exercised undue autonomy in arriving at make-or-buy decisions."

• **Many large contractors** are trading work with other large contractors. "The 20 largest defense contractors . . . in addition to receiving more than $11 billion in defense prime contracts last year, subcontracted to each other almost another billion dollars of defense work."

Senate Transport Study

Maj. Gen. John Doyle, director of transportation for the Air Force for four years before his retirement in 1956, will direct the staff making a comparative study of federal policies toward various modes of transportation for the Senate Commerce Committee headed by Sen. Warren Magnuson (D.-Wash.). Doyle has been associated with Transportation Consultants, Inc., of Washington, and with the Independent Airline Assn.

The 22 consultants on the study include R. W. Ireland, retired vice president of United Air Lines, representing Air Transport Assn.; Gwin Hicks, president of Lake Central Airlines, representing Association of Local Transport Airlines, and Lewis Burwell, chairman of Overseas National Airways, representing Independent Airline Assn.

Accident Summary

Civil Aeronautics Board last week, in its annual resume of aircraft accidents, reported a total of 90 air carrier accidents occurred during 1958, 15 of them fatal. Fatal accidents involving domestic airlines during the year totaled eight, with 20 crew fatalities and 119 passenger fatalities. Foreign and overseas operators were involved in two fatal accidents, with no crew fatalities and 10 passenger fatalities. Non-certificated carriers were involved in one fatal accident which resulted in the loss of two crew members. There were no passengers lost in the latter accident. General aviation accidents involving helicopters and fixed-wing aircraft in excess of 12,500 lb. gross weight totaled 122 during the year, 21 of them were fatal.

National Science Medal

A National Medal of Science, to be awarded by the President, was approved by Congress and sent to the White House last week. Recommendations for its award will be made by National Academy of Sciences on the basis of "outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences." No more than 20 awards may be made in a year. Legislation was sponsored by Rep. Victor L. Anfuso (D.-N. Y.) (AW Aug. 24, p. 25).

—Washington staff

Glennan Raps 'Exotic' Space Predictions

NASA administrator warns against rapid advances in multi-project programs without manpower, funds.

Westwood, Calif.—U. S. is "not nearly as far advanced in space technology as we had thought or hoped," Dr. Keith Glennan, administrator of National Aeronautics and Space Administration, warned last week.

"Our experiences in the space vehicle field have been less than completely satisfactory. The ratio of successful launches to what has been termed by some as 'successful failures' has not improved very much in the past year," Glennan said at the Fourth Annual Symposium on Ballistic Missiles and Space Technology at University of California at Los Angeles. Air Force Ballistic Missile Division and Space Technology Laboratories were sponsors.

"As soon as we began to plan for second generation experiments, we found that we were facing some hard facts of life in the propulsion and guidance fields," Glennan said.

"Even today, every shot we make—either by the military or by ourselves in NASA—is a shot in which there is little or no margin for even a slight deviation from planned performance parameters. In thrust capability, in guidance—injection, mid-course, terminal—in thrust control—in all of these areas there is much that must be learned and applied before we undertake the difficult missions we all talk about so glibly."

Space Predictions

The NASA chief also said "there seems to be a contest going on in this country in which substantial numbers of people are attempting to outdo each other in predicting exotic accomplishments in space in the next few years. In my opinion, there is need for more common sense and good technical judgment to be injected into this picture."

Glennan also pointed out, "it is becoming clear that we cannot and should not attempt to undertake all of the hundreds of projects that are being recommended to advance our understanding of the space environment. We haven't the manpower, facilities, or funds. More important than any of these, however, is the fact that it seems to me that we will make progress faster if we move at a rate that will enable us to understand a bit more about the things we have already done and the information we have already acquired from successful experiments that are behind us.

"Probably more than any other single matter, the question that plagues all of us is one of reliability. When will we be able to count on being successful in launching and placing into orbit or on the desired trajectory in deep space as many as three out of four of our intended experiments?

"We should admit, quite frankly, that with distressingly few exceptions, we have not achieved complete success in any mission to date—success in the sense that the payload has been injected into orbit or into a deep space trajectory within reasonable limits of the planned flight objectives and in the sense that the payload has performed its mission satisfactorily."

In addition to outlining problems concerning the space effort, Glennan also detailed some of the plans NASA has for the near and more distant future.

According to Glennan, "within the next year, I think you will be able to note an orderliness about the attack our people will be making in the space sciences area. Thus far we have been engaged in completing experiments planned for the IGY. In fields such as astronomy, metorology, and the physical sciences, we are developing a determined and planned program.

"Lead times for most of these experiments will be long and will call for continuing high levels of effort and support. Unless we can achieve this goal, we will lack, ultimately, the underpinning for the entire space program and may miss the really important discoveries that now lie hidden from our view.

"We plan to concentrate our initial efforts in deep space on lunar missions —near-miss, orbiting and hard and soft landings of payloads. In this program we will develop the techniques necessary to accomplish missions into deeper space and will use them for such missions as their reliability and the opportunity permits."

Glennan emphasized that "we have used up much of our missile technology. We have drawn heavily on our capital—the knowledge and experience accumulated by the military services, by industry and by NACA and others over the past 10 years or so. We must replenish that capital with new knowledge. From here on out, space research is going to be a matter of the same determined plugging away that has characterized aeronautics research—and indeed all scientific endeavor."

To remedy the situation, Glennan declared, "as to basic research and advanced technology—we expect to support greater effort in the universities, other non-profit institutions, and in industry in both basic research and advanced development of systems components. In the development of better methods and devices in the fields of guidance, controls, telemetry, auxiliary power units and sensors of all types—in all of these areas, we see the need for greater concentration of all effort. Through such actions we hope to improve the reliability of the systems which will employ these components."

Concerning booster systems, Glennan said "it is becoming increasingly apparent that greater efforts must be placed on simplification and reliability. As a corollary, it seems quite clear that continued attention must be given to reduction in the number and varieties of rockets and rocket booster systems for use in the space business. It is unlikely that these systems will become off-the-shelf production items in the forseeable future.

"With limited numbers of firings in prospect, reliability can be expected only if the variety of systems is kept at a minimum. It will be cheaper to waste payload space in using an oversized booster that becomes reliable through continued use than to tailor boosters for each specific mission with the attendant lower reliability that surely will result from infrequent use.

Development Costs

"Both the cost and development time will be prohibitive if vehicle development depends, as it does now, so heavily on 'trial by fire.' As a part of our program we are currently studying methods for development that might lead to earlier success of our flight vehicles, and the progress we make here may well determine how long it will take to do the advance mission that we are all so anxious to accomplish."

Glennan also pointed out that considerable materials research is being opened up by space exploration. He said that materials behave peculiarly under space environment, such as magnesium which sublimates in a vacuum, and metal surfaces which have a tendency to weld together by molecular adhesion. Effort is being extended in this direction, he said, to solve these and similar problems of materials in space.

The discovery of life on another planet would be one of the momentous

events of human history, Dr. Albert R. Hibbs, acting chief of Space Sciences Division at California Institute of Technology's Jet Propulsion Laboratory told the audience.

Such a discovery, however, would do more than answer universal curiosity; it would also be of enormous scientific interest, he said.

Next to the synthesis of living matter in the laboratory, this would be the most important step that could be made toward understanding the origin of life, according to the speaker.

Hibbs went on to say, "this country's program for exploring the moon and planets has as its scientific justification two of the most fundamental problems in all of science and philosophy—the origin of life and the origin of the solar system.

"For its technological needs, the program can call upon the most advanced technical society on the face of the earth.

"In return for the financial support of all the citizenry, it can offer realistically the hope of victory in our race with the Soviet Union for superiority in space technology.

"But it cannot look forward indefinitely to public support on the basis of international competition alone. Eventually, the program must rest solely on its scientific merit. If you believe in the merits of this program, then it is your job to awaken the similar belief in the mind and heart of your neighbor," Hibbs declared.

"Sputnik I was a humiliating experience for many Americans, therefore the competitive aspects of space voyages cannot be avoided entirely," Hibbs said. "Even the space technicians and foreign affairs experts who long to be free of the competition will not feel at ease until the United States has recorded a 'first.'"

Space spectaculars, failures and successes, have become another anxiety of the American scene, he claimed, adding:

"Most scientific experiments succeed after many attempts have failed. This is the accepted pattern in science. Space science does not enjoy this same latitude because it is so expensive and because the public takes failures so personally."

Hibbs pointed out that the ultimate value of space exploration depends on the merit of the scientific experiments it performs, and success of the experiments in turn depends upon rocketry know-how and the public's willingness and ability to finance it. It is partially the public's self-identification with the space program that makes it willing to finance it, so restrictions placed upon space science become all the more fearsome when the rival nation is not only successful, but appears to have succeeded upon its first attempt.

Therefore, Hibbs said, long range scheduling of flights becomes at the same time both essential and precarious, for at any time it may become necessary to drop the score and play by ear.

"This social situation," Hibbs continued, poses the question: "Is it possible for the space laboratories to conduct an efficient research and development program with the nation peering over their shoulders and periodically demanding spectacular action?"

Discussing the scientific data already available concerning other planets in the solar system, the origin of life and the solar system, Hibbs pointed out that although the possibility of detecting and studying life on other planets is the most exciting aspect in space exploration, the biological importance of space research is not limited to the study of extraterrestrial life.

"If no life is found on other planets the possibility of sampling the organic compounds on other worlds can yield invaluable evidence bearing on the origin of life," Hibbs said.

Atlas Near Operational Status

Cape Canaveral, Fla.—Fourth successful firing in a row of the Air Force-Convair Atlas intercontinental missile last week paved the way for a firing by USAF personnel that would demonstrate the missile's initial operational capability.

The four successful shots followed five unsuccessful flights in a row, two of which were caused by a fuel valve malfunction. After extensive ground testing led to three minor fixes in the fuel valve, the four heavily-instrumented missiles incorporating the fixes were fired to make certain the fuel flow trouble had been eliminated.

These missiles also carried out other standard test missions that would have been flown had no valve trouble developed.

Last week's shot carried a General Electric Mark II heat-sink nose cone equipped with a camera. The data capsule from the cone was ejected and recovered near Ascension Island, and if the pictures are successful they will show the earth from the highest altitude from which any photo has been taken—about 600 mi.

The four recent successful shots were missile 8-C, fired last July 21 with a General Electric RVX-2 ablation materials research nose cone; the 11-D, fired July 29; the 14-D, fired Aug. 11, and the 11-C, fired Aug. 24. The last three carried heat-sink cones. All four traveled approximately 5,000 mi. over the Atlantic Missile Range. First operational shot is due to be fired from Vandenberg AFB, Calif.

First operational static test firing of USAF's Atlas ICBM occurred at Vandenberg last week. Firing was conducted by a Convair crew under supervision of ARDC's Ballistic Missile Division, with representatives from Strategic Air Command's First Missile Division, and personnel of the 576th Strategic Missile Squadron also participating as part of their regular training on the Atlas weapon system.

Dyna-Soar Future

Washington—Dr. Herbert F. York, Defense Department director of research and engineering, said last week that the Air Force should establish final specifications for the Dyna-Soar program "within the next few months."

York, speaking at a National Press Club luncheon, said there is "no doubt that we want to" carry through the Dyna-Soar program but added that the Air Force is "having some difficulties in regards to coming up with precisely what it wants." Primary decisions yet to be reached, York indicated, revolve around finding ways to holding down the cost of Dyna-Soar, particularly in the field of boosters. "Big boosters," he said, "are very expensive, and we want to use the least number possible."

York described the Dyna-Soar as a "strictly exploratory vehicle, not a weapon system," that would be used to explore the flight regimes between the Mach 6 speeds of the North American X-15 and Mach 25.

Regarding the future of North American's Mach 3 F-108 fighter and B-70 bomber programs, York said that "we simply are not prepared to answer" whether either or both projects will reach the hardware stage. He said that "right now they both are under scrutiny because they are very large programs and naturally would be under scrutiny right now" while the Fiscal 1961 defense budget is being drafted in the Pentagon.

In citing reasons proposed by proponents of the B-70, York said that "some people have lingering doubts" about the capability and accuracy of missiles, adding, however, that "I don't have any doubts myself."

U. S. Urges Better Measuring Standards

New York—Industry is being urged—with the Air Force as prime mover—to take steps to advance U. S. measurement standard capabilities which are in danger of falling behind advancing technical requirements such as those in space projects.

Sperry Gyroscope Co., as sponsor of a project in this field undertaken by the Quality Control Committee of the Aerospace Industries Assn., last week reported the results of a survey that showed problems in areas such as standards of force for measuring thrust of large rockets and especially in the microwave, radio frequency and electrical fields.

Air Force will have precision calibration laboratories established at most large bases by the end of 1959 in a $6 million program. It is taking action to ensure that contractors have precision calibration systems of their own to further weapon system reliability. Air Materiel Command is working with AIA, the Electronic Industries Assn. and the National Security Industrial Assn. toward this end.

This effort will be broadened with the formation of a Department of Defense Group including representatives of the Army and Navy as well as USAF to survey all military calibration capabilities and to work on the problem of contractor capabilities. The group, headed by R. W. DeWitt of the Defense Department Office of Electronics, will have its first meeting Sept. 3.

The cushion between the standards and calibration available in the National Bureau of Standards and that required by industry is disappearing, according to Frank McGinnis, Sperry's reliability and quality control manager who heads the AIA committee. Unless work is done today to expand these capabilities, he said, the demand of tomorrow's weapon and space systems cannot be met.

There are two fundamental deficiencies:

• **Operating practices,** as in machining tolerances. Sperry cited its own experience where components to be assembled on a gimbal shaft required tolerances of 5 millionths to 10-millionths of an inch. When the various components from vendors were actually assembled, tolerances varied widely; yet, on checking, Sperry found each vendor had met the requirements as measured by his own equipment. The variation between the various calibration devices was plus or minus 30 millionths or a 60 millionths spread.

• **Technical requirements** especially for the future. One example is that there is now no standard for full daylight, which is needed in optical measurements for those working on astro-tracking systems. Another is that Bureau of Standards has no standard for measuring frequency of measures. It has no calibration service available in the low temperature range from 4 to 12 deg. Kelvin and there are problems in the high temperature range—above 1,336 K.

(Dr. A. T. McPherson of the Bureau of Standards pointed out that the Russians have calibration techniques in the high temperature range to 12,000 K.)

The AIA committee said that the Bureau of Standards by law has the responsibility for this development. Furthermore, the necessity for a central source for standards was emphasized. One value of the survey is to point out to the Bureau where problem areas lie.

Bureau Representatives

Bureau representatives were quick to acknowledge deficiencies, but there was no outright plea for more funds on the part of either the Bureau or USAF representatives or industry. Dr. McPherson noted, however, that Congress had increased funds for the Bureau in research and testing areas from $12 million to $17¼ million this year.

By implication, it was clear more funds for such work were regarded as essential. In the rocket field, one company in the survey listed the need for a standard for a million-pound-thrust rocket engine.

At present, the highest such standard available at the Bureau is 111,000 lb. utilizing dead weight—either carefully cast iron or cast steel. The present system of dead weight machines requires a building 35 ft. above ground level or about 2½ stories. A million pound capability would require a 100 ft.-high building large enough to accommodate the 40 x 40 ft. machines and associated equipment.

There is a possible element of economic interest for industry as well. Air Force has been writing reliability requirements into contracts, especially for avionic equipment, and initial production model samples must meet certain reliability tests before acceptance. Thus the question of manufacturing accuracy is becoming more important for contractors already and the adoption of future standards may determine how contractor performance will be measured.

The Sperry survey took the form of questionnaires which ultimately were answered by 77 companies presenting a good cross section of the various aviation industry technologies and of company sizes. The tabulated results showed these 10 key measurement areas and the specific trouble spots in each:

• **Dimensional.** Internal diameters below .250 in. presented the greatest problem, with almost half the 52 companies working in this field reporting insufficient accuracy. Problem accuracies ranged from .000002 in. to .000050 in. with greatest concentration at .000005 in. Best the Bureau of Standards can offer is the probability of being able to measure down to .040 in. in about a year. This is a particular problem of companies making guidance systems, fire control systems and the like. The report pointed out that responses of companies claiming this is not a problem area should be viewed with reservation since accuracies reported are finer than the Bureau can attain and often cannot be justified by comparison to the instrumentation used. Internal diameters above .250 and external diameters generally present almost equally pressing problems. Length measurement, angle, thread, and gears present few problems.

• **Optical.** This is a lesser current problem area but company opinion was strongly for establishing national standards for full daylight as well as for a certain star of a specific color temperature and for precise measurement of angular differences between two lines of sight as established by optical systems.

• **Temperature and humidity.** This is not a great problem area, with Bureau of Standards gaps in the 4-12 K range and above 4,500 K. However, a number of companies reported problems in the

Soviets on B-70

Moscow—Soviet military quarters have expressed unrestrained glee over U. S. Air Force and Navy cancellation of production plans for high-energy boron aircraft fuels. They regard the moves as further proof of American scientific weakness.

The official Russian air force newspaper, Sovetskaya Aviatsiya, says that halting the development of high-energy fuel and the General Electric J93-5 chemical engine "make it entirely obvious that the widely-advertised (North American) B-70 chemical bomber project has actually burst like a soap bubble.

"High-ranking representatives of the American militarists are still trying to assure the public that nothing out of the ordinary has happened and that the B-70 will be built to use conventional jet fuel. But at the same time Pentagon personnel, anticipating the final collapse of the B-70 project, are even now preparing American public opinion for this eventuality."

90-873 K, 873-1,336 K and 1,336-4,500 K ranges—areas not the most difficult to measure, indicating that this is an exchange-of-information problem rather than a technical development matter.

• **Shock, vibration and force.** Relatively few companies are concerned in this area and most plant capabilities are adequate except when indications of advanced work appears. These appear to center in situations where acceleration must be measured coupled with shock or vibration. Four companies were concerned with force (thrust) measurements in 300,000-1,000,000 lb. range.

• **Microwave.** Problems were reported in most of the 42 microwave categories listed. Every company concerned with the subcategory, "Loaded Q of tunable frequency meter," reported difficulty. Attenuation in all decibel ranges was mentioned. So was noise figure, especially for microwave receivers and klystrons.

• **Radio frequency.** Problems existed in about half the subcategories in this area. Major problem areas appear to be CW voltage, power, attenuation on unbalanced lines. Calibration of sinewave signal generators and measurement of impedance also are trouble areas.

• **Electrical.** Problems here were reported on fewer than half the subcategories. Major ones were measurement of a.c. voltage from 1-300 v., measurement of d.c. resistance of standard resistors, measure or d.c. voltage with digital voltmeters and measurement of d.c. voltage ratio of standard voltage dividers.

• **Pressure.** A less critical area, pressure problems were reported most in the liquid flow category. Problem accuracies here were in the .10%-1% range.

• **Infrared.** Because of the relatively few companies in this field, it was termed a no problem area at present. But large gaps in Bureau of Standards capabilities plus indicated future requirements might change this soon. Infrared emissivity values of most temperature ranges and materials are needed; replies were broken up evenly over-all.

• **Radiological.** Accuracy is not so much a problem here as agreement of primary sources and a choice of best procedures to follow for calibration of the many in use. Certification of film badge companies by some central agency was recommended by most companies.

Defense Ban of Gen. Power Book Sparks Moss Committee Probe

By Craig Lewis

Washington—Defense Department ban prohibiting publication of a book by Gen. Thomas S. Power, commander of the Strategic Air Command, concerning the potentially explosive issues of the U. S. strategic military posture has triggered an investigation by the House Government Information Subcommittee.

House group, headed by Rep. John Moss (D.-Calif.), is conducting a staff investigation of the ban and is demanding a full explanation by Defense Secretary Neil McElroy of his action and of the policies involved.

Originally scheduled for publication this fall, Power's book deals with the broad issues of the military problem the U. S. faces in its cold war struggle with the Soviet Union. As its title, "Design for Survival," implies, the book also offers a plan for an effective long-term military posture for the U. S. Much of the material was presented in testimony to Congress and reprinted by Aviation Week (AW April 20, p. 66) and in public speeches.

Permission to publish the book was denied by McElroy under a long-standing policy prohibiting top military and civilian defense officials from writing about their offices or commands while they still hold them. But the potentially explosive questions involved in the problems of U. S. strategic power policy, such as whether Navy's Polaris missiles will be assigned to SAC, undoubtedly influenced the decision to keep the book out of print.

Idea for the book grew out of Power's discussion of strategic power concepts and realities during briefings for civic and business leaders held frequently at SAC headquarters. It was suggested that Power should put his ideas in written form, and Random House obtained publication rights.

Before writing the book, Power asked and received permission from Air Force Secretary James H. Douglas. Power asked the Air Force public relations organization to handle publishing arrangements, and he specified that royalties go to USAF charity funds. He also suggested that this might be a good policy for all top officials writing books on military subjects.

Manuscript was submitted for security review in April. Because of its special character, the book was reviewed at higher levels, and McElroy decided against publication, although Gen. Power still has no official word.

Defense Department said approval was denied because it would not be appropriate for a commander of a major command to write a book concerning his area of responsibility while he is still on active duty in his command. The department said its disapproval is aimed at barring a copyrighted book for a restricted audience, and that Power is still free to express his views in speeches, and interviews available free to the public.

Defense Department has had a policy since 1954 barring top military and civilian defense officials from writing exclusive articles for publication. This policy stems from an agreement between the service secretaries and the-then Defense Secretary Charles E. Wilson. It allows for an appeal to the Secretary of Defense in special cases, and apparently it was that type of appeal that McElroy turned down.

Defense Department policy bars top officials from discussing official business in exclusive articles and books, but there is some leeway allowed for the writing of personal experiences and for scientists writing for technical journals.

House Government Information Subcommittee investigation of the Power incident was still under way last week. At the same time, the House group wrote to McElroy asking for an explanation of the policy prohibiting high-ranking officials from writing signed articles for the general press and for general circulation magazines but allowing them to write for a number of service publications.

The House group cited a memorandum to the Defense Department Office of Security Review from Chauncey Robbins, Deputy Assistant Secretary of Defense for Public Affairs, which listed 23 official service publications and 35 semi-official publications in which top officials could publish signed articles. Memorandum said that signed articles would not be cleared for use in any publications not on the list.

The Moss letter to McElroy said the ban on writing for general circulation magazines and newspapers seems to conflict directly with previously defined public information policy stating that the public is interested in Defense matters and that the Department of Defense has an obligation to keep the public informed on its activities and the activities of the individual services.

Only restriction on this policy was a stipulation that articles dealing with military matters be submitted for security review. Authors were to do the writing on their own time and without the use of Defense Department facilities or personnel.

Observing that this policy conflicts with Robbins' memorandum, the House group asked McElroy whether the prohibition against signed articles by top officials applies to all general circulation magazines, newspapers and syndicates, what levels of rank are included in the prohibition and what statutory or other authority is claimed for the prohibition.

USAF, Navy Explain Boron Cancellation

By Ford Eastman

Washington—Air Force and Navy spokesmen last week claimed that technical considerations outweighed budget problems in the two services' cancellation of high energy boron fuel development programs.

Rear Adm. Robert E. Dixon, chief of the Navy Bureau of Aeronautics, told the House Committee on Science and Astronautics that a 1958 decision to shift emphasis from high performance attack and fighter aircraft to slower planes that would serve as platforms for high performance missiles resulted in a 75% reduction in Navy's requirement for high energy fuels.

Air Force decision to switch from General Electric's J93-5 jet engine for the North American B-70 Mach 3 bomber which would use boron fuels in the afterburner to the J93-3 engine designed for hydrocarbon fuels also reduced USAF requirements, Joseph V. Charyk, Air Force assistant secretary for research and development, told the committee.

As a result, plans to open two newly constructed plants each capable of producing five tons of boron fuel a day were canceled (AW Aug. 17, p. 26) just before they were ready to go into production, the officials told the committee. Construction costs for both plants amounted to about $80 million. Air Force and Navy expenditures for the boron fuel development program totaled about $240 million.

Both Adm. Dixon and Charyk were called by the committee to explain why the high energy fuel programs were canceled. Other witnesses testified for the National Aeronautics and Space Administration and the two principal firms involved, Callery Chemical Corp. and Olin Mathieson Chemical Corp.

Purpose of the hearings, according to committee chairman Rep. Overton Brooks (D.-La.), "is to determine why it took the service five years and more than $200 million to determine that they have no requirement for the fuel."

Brooks said the committee also is interested in determining NASA plans for use of the fuel and other possible uses for the facilities. The Navy's plant at Muskogee, Okla., costing $35 million, was to have been operated by the Callery Corp., while the USAF plant at Model City, N. Y., built at a cost of $45 million, would have been operated by the Olin Mathieson Corp.

Adm. Dixon told the committee that in 1952, when the Navy's high energy fuel project was initiated, there was a definite requirement for such a fuel to increase performance and reduce aircraft size. Since that time, Adm. Dixon said, performance has been increased through improvements in aerodynamics and conventional fuel.

Adm. Dixon, who also noted the shift in emphasis from aircraft to high performance missiles, said a number of problems were encountered in the use of boron for fuel. These, he said, include handling problems due to the toxicity of the fuel (see p. 23), the logistic problems associated with fleet usage and high cost of producing the fuel itself.

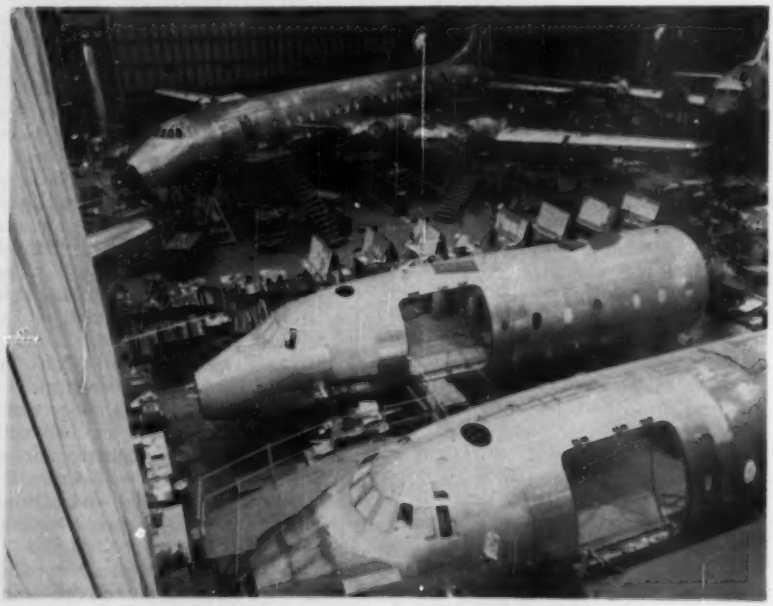
Future of boron-based fuels for Navy application, Adm. Dixon said, now rests upon continued developments of compounds and systems recently begun in the field of liquid monopropellants, additives for solid propellants and other boron compounds.

Charyk said that for some time, it has been growing more apparent that much of the early promise of the boron fuel could not be realized on a timely and economical basis. He added that, due to improvements in the efficiency of the B-70, the range available by use of high energy fuel became less critical. In addition, he said that an advanced version of the Boeing Bomarc interceptor missile, a potential user of boron fuels, has not become an active program. He added, however, that the Air Force has and expects to continue an active research and development program in the application of boron compounds to rocket propellants and advanced ramjets.

Emerson W. Conlon, NASA assistant director of research, said his agency has no requirement for the two boron fuel plants since the amount of fuel used by NASA in the high energy fuel research program is small.

Conlon said that research on use of boron fuels was initiated in 1946 by the National Advisory Committee for Aeronautics, NASA's predecessor, and that a total of $3.5 million was expended by the agency. Although boron fuels offer obvious advantages of increased power for jet powerplants, Conlon said, many problems have been encountered. These include:

- **Fuel injection**—boron fuels decomposed at high temperatures and tended to form a solid before complete burning. This was solved by designing fuel injection nozzles that mixed air with the boron, thereby obtaining rapid burning.
- **Fouling of engine**—products of combustion became a liquid below about 3,000F and, as the temperature decreased, the liquid adhered to various parts of the engine. At 850F, he said, it became a solid. The problem could



Turboprops Installed in First CL-44

All four Rolls-Royce Tyne R.Ty.12 turboprop engines rated at 5,730 eshp. each have been installed in the Canadair CL-44 in the background, left. Seaboard & Western Airlines has ordered five CL-44D-4s and has an option for five more; Flying Tiger Line will purchase 10 of the 400 m.p.h. swing-tail freighters and has an option for five additional (AW May 18, p. 41). Canadair, Ltd. is also building 12 CL-44s for RCAF.

be solved by increasing the temperature of the engine along with other modifications, but it was found that the problems of using boron fuels in afterburners and ramjets were easier to solve.

• **Loss of power at high temperature**—experiments on a full scale afterburner indicated that, if operating temperatures were raised from 2,500F to 3,000F, a 10 to 12% loss of energy was encountered. At 3,000F, the boric oxide did not condense into a liquid while passing through the nozzle, and the energy corresponding to the heat of vaporization was lost. Nozzle was therefore modified.

• **Fuel handling and thermal decomposition**—although boron fuels are toxic and are subject to decomposition at elevated temperatures, solutions were found for designing satisfactory fuel systems for aircraft. Results from the research program demonstrated that satisfactory ramjets and afterburners can be developed.

Conlon said that NASA recently has initiated research on boron hydrides as fuels for rocket motors since boron will combine with nitrogen in about the same way hydrogen unites with oxygen. This fuel, he said, is more powerful than some conventional rocket fuels such as oxygen-hydrocarbon and more stable than the most powerful rocket propellants, such as liquid hydrogen and oxygen or hydrogen and fluorine.

BuWeapons Drafts Organization Plans

Washington—Navy's new Bureau of Naval Weapons, merging the functions of the Bureaus of Ordnance and Aeronautics, which begins its official life tomorrow, is designed primarily to provide a single-line approach to weapon system development.

The bureau, which probably won't become operational until about Jan. 1, will include four line operational divisions, each under an assistant chief with the rank of rear admiral—research, development, test and evaluation; procurement and production; fleet readiness, and field support.

In addition, a staff-level assistant chief for program management will be designated in an effort to provide centralized guidance to the bureau's research, development and production projects. Aside from over-all planning assignments, he will be given executive authority for managing anti-submarine warfare, air defense, strike warfare and support and logistics programs.

A sixth assistant chief of the bureau will head the Inspector General's office.

Both the Bureaus of Aeronautics and Ordnance will continue to function for an interim period until the new bureau actually becomes operational.

Space Technology

NASA to Receive Scout in Month

Dallas—Delivery of first of four Chance Vought Scout four-stage solid-propellant space research vehicles will be made to National Aeronautics and Space Administration's Wallops Island, Va., test station in approximately 30 days. Indications are that NASA will make the first Scout shot this year, probably not an orbital one, according to a source close to the agency. Test series of the initial Chance Vought vehicles will probably be complete in mid-1960.

Chance Vought last week assembled and mounted a Scout test model in a special 109 ft., 60-ton tower it has designed and built as part of its contract for approximately $1 million from NASA. Demonstration was test of the tower's systems prior to tearing it down for shipment to NASA's Wallops Island facility.

NASA's current Scout program calls for launching all four vehicles from Wallops and indications are that further orders for Scouts may be forthcoming, depending upon the success of this initial program. USAF also is studying the Scout as a possible vehicle for its space research programs and will monitor NASA's tests at Wallops.

Scout's basic missions will be to put a 150-lb. payload into a nominal 300-mi. orbit; on a high-altitude shot, it could carry a 100-lb. payload approximately 5,000 mi. It could be used for high-altitude probes or as a re-entry test vehicle. Launcher is designed to fire the 35,000 lb. gross weight Scout either from a vertical position or any desired angle up to 20 deg. from vertical.

Chance Vought's contract calls for integration of the vehicle, building the launcher, development of nose section and airframe protecting NASA-developed instrument payload, sections between the stages, stage separation devices, jet vanes and fin assemblies.

Cost of each Scout is estimated at approximately $500,000. An NASA source indicated that the agency expects that it can do basic space research with the solid-propellant powered vehicle at approximately half the cost of a similar liquid propelled rocket.

Scout is assembled at the tower site. Initially, the first stage, an Aerojet-General Senior, is attached to the launcher arm, swung down by cables and winched to the horizontal, by three pin and socket connections. Two pins secure the tail section; a V-arm with a split pin holds the forward section. On launching, the V-arm springs apart to permit the Scout's tail fins to clear the launcher.

Thiokol second stage, an improved Sergeant, is bolted to the first stage while the latter is horizontal. Then the first two stages are winched to the vertical and successive stages are lifted by the launch tower's 3,000-lb.-capacity hoist and attached. Third stage is a Bureau of Ordnance—Allegany Ballistic Laboratory X-254 and fourth stage is a BuOrd-Allegany X-248. A hydraulic piston is secured to the launching arm and the cable and winch are disconnected, permitting the piston to adjust the launcher to any position out to 20 deg. from vertical.

Initial stability is provided by four fins, having movable tips connected to the same shaft as vanes in the jet blast. Fin tips will stabilize the vehicle following burnout of the vanes. A comparatively simple Minneapolis-Honeywell gyro-type guidance system is employed, programed to provide proper flight path for the particular mission. After separation of the fourth stage, stabilization on second and third stages is provided by reaction jets using hydrogen-peroxide fuel. Stage separation is programed and uses blow-out diaphragms.

Fourth stage is fitted with stainless steel heat shields to protect the payload during ascent through the earth's atmosphere, and are separated by ballistic actuators to expose payload. Blunt nose cone is a nickel-alloy designated René.

Completion of test vehicle, which will be tested to destruction at Chance Vought's Dallas plant, was accomplished in four months.

Soviets Claim Il-18 Sets Payload Records

Moscow — Soviet Il-18 turboprop transport set five world records on Aug. 19 for high altitude transport of payloads, the Russians report.

The aircraft, with a 15-ton payload, flew 1,245 mi. between Moscow-Melitopol-Moscow in 2 hr. 47 min. for an average speed of 447 mph. "This is a new world high for planes with piston and turboprop engines," the newspaper Sovetskaya Aviatsia said.

The newspaper said the flight also bettered previous world records for aircraft carrying 1, 2, 5 and 10 ton payloads.

Although Sovetskaya Aviatsia said flight information had been forwarded to Russian authorities for confirmation as a USSR record it did not say whether documentation also was sent to Federation Acronautique Internationale for registration as world records.

Navy Cancels P6M Production; Martin Plans to Lay Off 3,000

Washington—Final decision to terminate the Martin P6M jet seaplane program leaves Navy with four flyable aircraft out of the 32 originally programed, although a total of 12 prototype and production models have been built and another two are in the final assembly stage.

Four of the six developmental YP6M aircraft powered by four 10,000-lb.-thrust Allison J71 turbojets that were built have been partially dismantled, and a fifth was intentionally destroyed in static tests, leaving one of the planes in a flyable condition.

In addition, Martin has turned out four production model P6M-2s powered by 15,000-lb.-thrust Pratt & Whitney J75 turbojets, and two others are in final assembly. Only three of these have been accepted by the Navy, with the fate of the others depending upon final negotiations for contract termination between the Navy and Martin. Chances that they will be accepted are small.

Martin also had built two XP6M prototype versions of the jet seaplane, both of which were lost during the development program. First crash cost four lives, but the crew of four left the second XP6M safely during an inside loop at nearly maximum speed.

Both crashes were attributed to failures in the P6M flying tail, the first to a control malfunction and the second to a failure in the hydraulic system. Martin and Navy officials had concurred in the past that the necessary steps had been taken to forestall recurrence of either malfunction.

Total of aircraft planned under the program has declined steadily since its inception several years ago. Originally, 24 production models, six YP6Ms and two prototypes were planned. The number of production aircraft was subsequently trimmed to 18 and then to eight (AW Dec. 1, 1958, p. 30).

Late last week, the Navy had not yet determined what use will be made of the P6Ms on hand. If the eight production models planned earlier had been produced, they would have been operated as a squadron from Harvey Point, N. C.

The Harvey Point facilities will now be placed in reserve, and work will be canceled on conversion of an LSD (landing ship, dock) to accommodate the aircraft.

Following the Navy announcement, which Martin officials termed "sudden" and "unexpected," the company reported that it would be forced to lay off 1,060 employes at its Baltimore plant by late last week, and a total of up to 3,000 will be released within the next two weeks.

In announcing the termination, a Navy spokesman said that "the original concept was good but has been overtaken by unforeseen technical difficulties." He later added that "the overriding urgency and importance of other Navy programs made the additional expenditure of funds for the seaplane evaluation project unjustified."

The Navy, which already has spent approximately $400 million on the program, estimates that the termination will save about $72 million.

Quoted Testimony

Martin spokesmen flatly denied that the P6M was suffering from technical difficulties and, in support of this position, quoted congressional testimony by Rear Adm. R. E. Dixon, chief of the Bureau of Aeronautics, in April that the aircraft "has very superior performance."

So far as immediate effects upon the company's financial outlook is concerned, Martin board chairman George M. Bunker said the cancellation is "not of great magnitude."

Bunker said the termination represented approximately 5% of Martin's current backlog and that it will affect this year's earnings by about 4%.

Navy Radio Telescope Construction Delayed

Construction of the world's largest radio telescope—the Naval Research Laboratory's 600-ft. diameter parabolic antenna being installed at Sugar Grove, W. Va.—is lagging while specifications for the 55-ft. square panels making up the dish are being redrawn.

The facility, which is to be known as the U. S. Navy Radio Research Station after its completion sometime in 1962, is located in a valley on the edge of the George Washington National Forest within the "electronic quiet zone" established by the Federal Communications Commission.

The delay has arisen because subcontractors bidding on fabrication of the panels, which measure 55 ft. in width and between 55 ft. and 65 ft. in length, depending on their position relative to the dish's center, objected to the required tolerance of 1/16 in. over the entire face of individual panels as they were originally designed. The antenna with its supporting structure will weigh more than 20,000 tons.

Already installed on site is a 60 ft. parabola that probably will be used in conjunction with the larger dish for acquisition of targets and comparative measurements. Radio astronomy is only one of several uses to which the large antenna will be placed. Although the Navy will not discuss other uses, they probably include tracking of satellites and deep space probes both actively and passively, cross-section measurements on satellites and probes, propagation through the earth's atmosphere and ionosphere, and related studies.

At present $79 million has been appropriated for the telescope and support facilities. The dish, according to present design plans, will have an approximate focal length of 240 ft. and will be capable of operating through the VHF and UHF frequency ranges. Low noise receiver front ends that are being studied for possible use include Masers and parametric amplifiers.

The parabola will be supported by a central pintle and rotated in azimuth along circumferential tracks supporting the dish along the elevation axis. The feed assembly will be held by three towers erected from the dish surface in the form of a pyramid. To provide precise target tracking and compensate for the earth's rotation, a highly accurate antenna position control system is under development that includes inertial elements.

Once in operation the antenna is expected to extend the range of present radio telescopes by more than a factor of 10, and of optical telescopes by a factor nearer 20. At a frequency of 100 mc. the approximate beamwidth will be one degree and the gain 40 db., including allowances for degradation of performance due to the large size of the antenna.

Architects and engineers for the project are a combination of three firms: Frank Grad & Sons; Urbahn, Brayton & Burrows; and Seelye, Stevenson, Value & Knecht. Prime contractors on a joint bid basis for the construction are: Tidewater Construction Co., Norfolk; Peter Kiewit Sons, Omaha; and Patterson, Emerson & Comstock, Inc., Pittsburgh. U. S. Steel is subcontractor for the steel for the antenna and support structure.

Hound Dog Launch

Cape Canaveral, Fla.—Third USAF-North American Aviation Hound Dog air-to-surface missile has been fired over the Atlantic Missile Range from a Boeing B-52 bomber. In the firings thus far, aircraft have flown from Air Proving Ground Center at Eglin AFB, Fla., and released their missiles in the general area of Grand Bahama Island, location of the first island tracking station along the 5,000-mi. range.

Premature Ignition Halts Little Joe Test

Washington—First National Aeronautics and Space Administration Little Joe flight test of Mercury capsule hardware failed when the escape rocket fired prematurely, carrying the capsule away from its modified Little Joe booster before launch.

Full-scale boilerplate capsule was carried to an altitude of about 2,000 ft. when its prototype escape system fired 20 min. before launch at NASA's Wallops Station, Va. Capsule fell into the Atlantic 1,000 ft. from the launch pad and was a total loss. Programmer which was to ignite the escape rocket was not connected at the time, and the cause of the premature ignition was not determined.

Initial Little Joe launch of the Mercury capsule was scheduled to test the escape system under high dynamic pressure loads. Grand Central escape rocket would have been fired at an altitude close to 40,000 ft. to provide data on the system in this critical area.

Unfired Little Joe booster was not damaged and will be used in future tests. This booster was modified somewhat from the usual Little Joe configuration, which has four Castor and four Recruit solid-propellant rockets. Booster on the initial test used two Pollux rockets in place of the four Castors since NASA did not need sustained high thrust for the relatively low-level test.

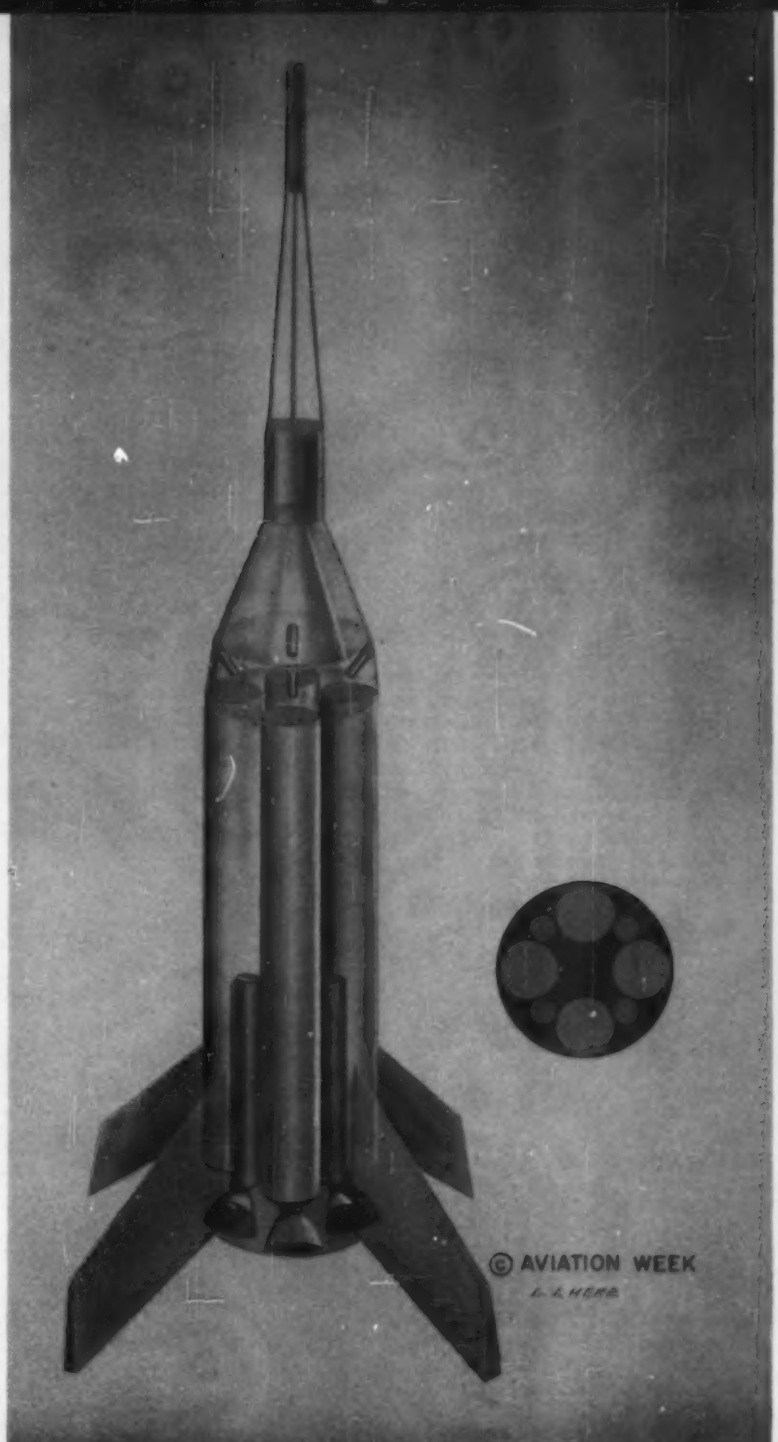
Pollux is a version of a Polaris test vehicle made by Thiokol. Castor is the newer rocket and uses a higher energy fuel. Both have the same diameter and propellant configuration as the Sergeant engine, but are longer, use more powerful propellants, and have a different case and nozzle.

The first Little Joe used two Pollux rockets and two Pollux dummies for ballast plus the Recruits and four Falcon retrorockets.

Little Joe using four Pollux and four Recruit rockets will provide close to 250,000 lb. thrust. Total thrust of the Little Joe with four Castors and four Recruits is in the same class as the Atlas, which develops 360,000 lb. thrust. North American Aviation assembles the boosters for NASA.

Failure of the first attempt to flight test Mercury capsule hardware with a Little Joe booster may set that program back to some extent, but it will not affect the schedule for Big Joe tests with Atlas boosters.

Rockets form a cluster of eight, with centers of all falling on the same circle (see drawing). Bottom of all eight rockets will be attached to the shroud, or the straight cylindrical portion of the airframe.



MAIN PROPULSION unit of Little Joe rocket consists of four M-58 Falcons, four XM-19 Recruits and four XM-33 solid propellant rockets. XM-33 comes in two versions, the E4 (Pollux) and the E2 (Castor). Castor uses polybutadiene-acrylic acid propellant binder and Pollux uses polysulfide propellant binder. Nozzles on XM-33 and XM-19 rockets are canted outward; on the M-58, nozzles are straight. Firing sequence is: first, two XM-33s (long cases in the drawing) and then the four XM-19s (the smaller diameter rockets). Two dummy XM-33s were carried in the first Little Joe booster, but in cases where all four are live, the other two XM-33s fire next. Separation of the booster from the vehicle is effected by firing the four M-58 Falcons (small rockets at the top of the booster in drawing). The small Grand Central escape rockets fire on descent to separate the escape pylon from the vehicle.

GAO Charges F-102 Overpriced; Naish Defends Convair Estimate

By Katherine Johnsen

Washington—General Accounting Office has charged in a report to Congress that the Convair Division of General Dynamics Corp. knowingly overpriced a $300 million fixed-fee incentive contract for F-102A all-weather interceptor and TF-102A aircraft by over $12 million.

GAO has asked the Air Force to obtain a downward adjustment of the costs in final negotiations. Unless this is done, GAO says Convair will still realize an excessive profit of approximately $3.4 million on the program.

In defending the company's cost estimates, Convair President J. V. Naish wrote the GAO:

"Much might be written on the subject of the complex character and 'beyond-the-state-of-the-art' requirements of the supersonic all-weather interceptor aircraft involved. . . . Much might be said as to the skill and ingenuity and efficiency with which procurement under this contract was effectuated . . .

"Attention may appropriately be directed to the studied limitation of the cost inquiries of your representatives to but a part of the contractor's task and cost and risk . . . and to the failure of the report to set out the fact that on a contract involving . . . over $300 million . . . the indicated over-all cost variant . . . appears to be approximately 2.4% and the profit variant .56%. On a fixed price contract, it is submitted that this result indicates a very accurate and very efficient price negotiation accomplishment on the part of both contractor and the Air Force."

Meanwhile, a controversy between GAO and Convair over the access of GAO investigators to company files on the Atlas ICBM and B-58 programs (AW Aug. 24, p. 33) appeared to have been solved after intervention by the House Armed Services Investigating Subcommittee headed by Rep. Edward Hebert (D.-La.). In response to a subcommittee protest that the investigators had been denied access to company files on these projects, Frank Pace, General Dynamics board chairman, wired Hebert:

"There is absolutely no intention on the part of this corporation to deny the General Accounting Office access to any records to which it is entitled. In fact, I personally am fully sympathetic with the need for review by government representatives of pertinent records under public contracts . . ."

Afterwards, Hebert issued this statement: "I am convinced that Mr. Pace himself had no knowledge of actions of the controller and manager of the Convair Astronautics Division at San Diego and of the Convair vice president and general counsel at San Diego."

GAO had claimed that Convair submitted excessive costs "which were known to the contractor or which the contractor could reasonably have expected to incur" in these three categories on the F-102A contract:

- **Material and purchased parts,** $8.6 million. As an example, GAO reported that the company used a unit price of $8,790 for 562 refrigeration packages. The agency said that before the cutoff date for preparation of the target price on the contract, Convair had issued purchase orders for 468 of the units at an average unit price of $2,540.

GAO said that it arrived at the $8.6 million over-charge by comparing Convair's proposed target costs for all material and purchased parts items over $100 with prices of items already on order.

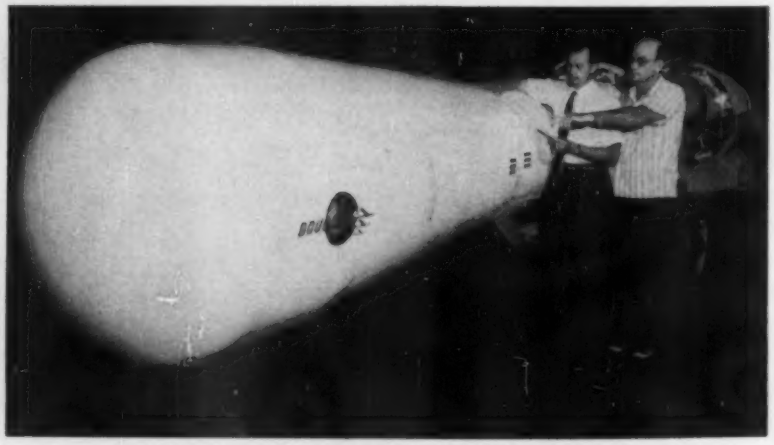
- **Subcontracted items,** $1.3 million. GAO said Convair's cost estimate for subcontracted items in the contract exceeded the actual costs being incurred at the time by $1.2 million. The application of a shop loss and price increase factor to this amount increased the overestimate to $1.3 million, according to GAO.
- **F-102A cost increase** because of a reduction in the TF-102A order, $2.2 million. During negotiations, the procurement of TF-102A aircraft was cut from 131 to 63, and Convair estimated a $2.2 million increase in the cost of parts common to both the F-102A and the TF-102A because of the reduced requirement. GAO said that the cost increase should not have been included in the target price, since, at the time of cancellation of the TF-102As, negotiations were under way for a follow-on contract for an additional 140 F-102As.

GAO also criticized the Air Force for failing to have Navy auditors located at the Convair plant as representatives of the Department of Defense review the cost estimates submitted by the company. "The proper application of auditing techniques to the contractor's target price proposal, prior to negotiation of the target price, would have disclosed that the contractor's cost estimates were unreasonably high," GAO said.

The Hebert subcommittee heard GAO's presentation of the Convair investigation in connection with a study it began at the beginning of the session on weapon system contracting (AW May 18, p. 28).

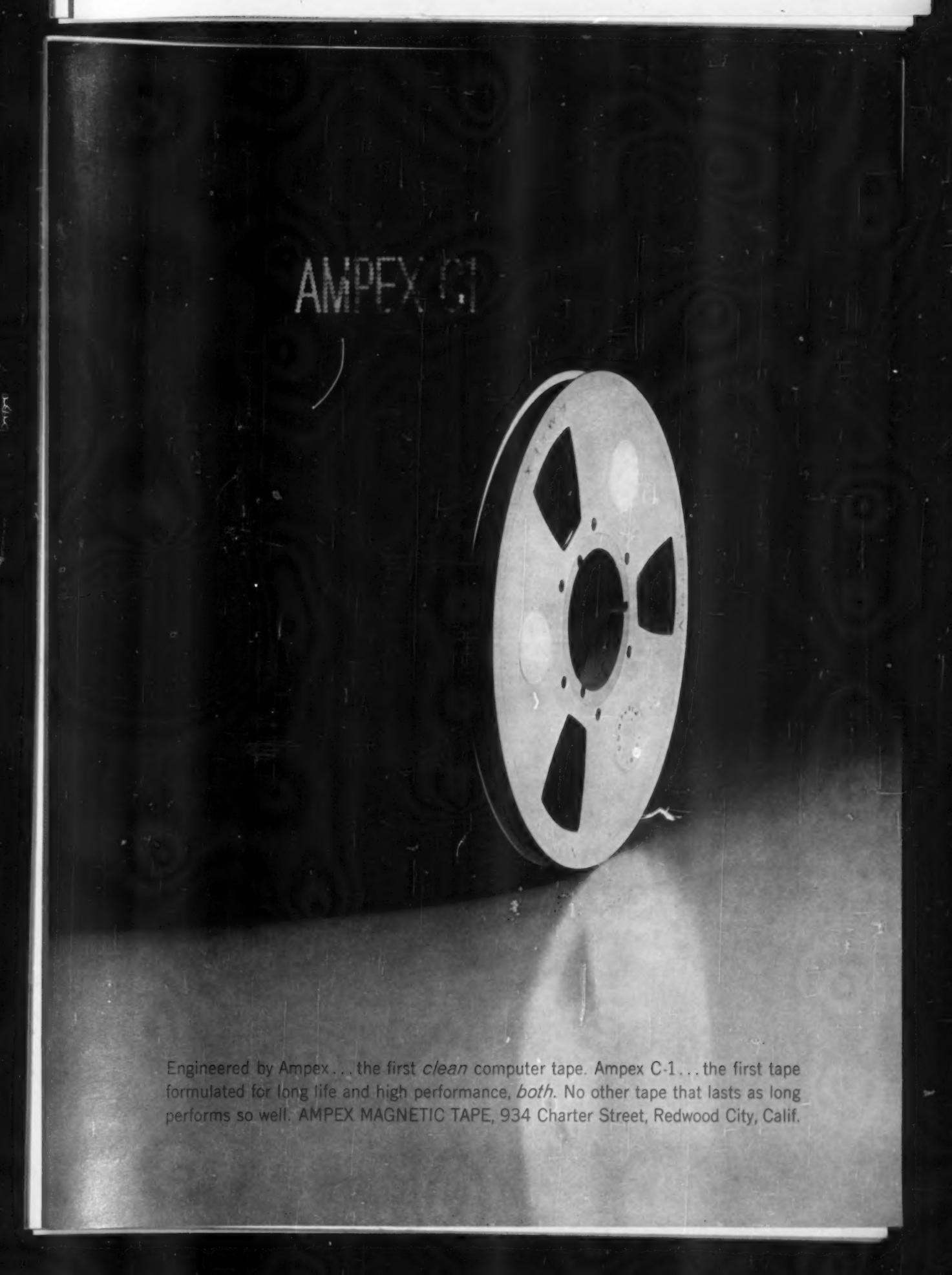
In previous presentations, GAO has charged 14 USAF contractors with overpricing totaling $30 million (AW June 8, p. 26) and 12 Navy aviation contractors with over-pricing totaling $13 million (AW July 20, p. 28).

The subcommittee last week was scheduled to end its special investigation of allegations of "munitions lobby" influence in defense procurement (AW Aug. 24, p. 33). According to subcommittee counsel John Courtney, a report will be issued during the coming congressional adjournment and legislation prepared for the next session.



Delta Space Vehicle Unveiled

Second and third stages of National Aeronautics and Space Administration's Delta space research vehicle are shown above. Delta, for which Douglas Aircraft Corp. is prime contractor, has same configuration as Thor-Able, used by USAF and NASA for space probes (AW Feb. 2, p. 37). First stage of Delta is a modified Thor, the second stage is an Aerojet-General liquid propellant engine, and the third stage is an Allegany Ballistics Laboratory solid-propellant rocket.



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Meets new NAS 1291

SPS FN-12 Featherweight locknut replaces NAS 679 and equivalents*—saves up to 72% in locknut weight

SPS FN-12 Series Featherweight locknut was the first to meet new NAS 1291 calling for a lighter weight replacement for NAS 679 sheet metal nuts. New forged featherweight offers major weight savings, superior performance, high reliability; also permits secondary weight reductions through use of narrower bolting flanges.

Here is one of the few nuts that meet new NAS 1291 standard calling for a lighter weight locknut interchangeable with NAS 679 sheet metal nuts. The new SPS FN-12 weighs 12-60% less than its NAS 679 counterparts . . . and 12-72% less than equivalent MS or AN types. Yet it sacrifices none of the static or dynamic properties of these larger, heavier nuts. It provides 160,000 psi tensile strength on a 180,000 psi bolt and gives greater bolt tension-tension fatigue strength than any other lightweight locknut tested.

The FN-12 saves weight in another way also. Because of its new configuration, it can be installed closer to vertical bulkheads than any other aircraft nut now in use. This allows a narrower bolting flange, with consequent reductions in aircraft weight.

You can specify FN-12 Series Featherweight locknuts in 11 sizes—#4 through 5/8 inch. All sizes are available for immediate delivery. From #4 to 1/16", FN-12 locknut prices are practically the same as NAS 679 locknuts. In the size range including 3/8" and above, prices are considerably lower.

For more information, write SPS—manufacturer of precision threaded fasteners and allied products in many metals, including titanium. Request Bulletin 2426.

ACTUAL WEIGHTS OF FN-12 AND COMPARABLE LOCKNUTS

All Weights Expressed as Pounds per 1000 Pieces

Size	FN-12	NAS 679†	% Weight Saved by FN-12	AN Series‡	% Weight Saved by FN-12
#4-40	0.4	0.8-1.0	50%-60%	1.3	69%
#6-32	0.7	1.3-1.7	50%-60%	2.5	72%
#8-32	1.2	2.1-2.5	43%-52%	4.2	71%
#10-32	1.5	2.5-2.8	40%-47%	4.6	67%
1/4-28	3.5	3.9-4.7	12%-26%	8.5	59%
5/16-24	5.4	6.4-7.2	16%-25%	11.8	54%
3/8-24	7.3	9.3	21%	19.5	63%
7/16-20	14.7	16.0	8%	22.6	35%
1/2-20	21.0	—	—	43.5	51%
9/16-18	24.4	—	—	71.5	66%
5/8-18	33.8	—	—	87.3	61%

†Range of four most commonly used sheet metal nuts of NAS 679 type

‡Range for AN 363, 364, 365

*MS 20364, MS 20365; NAS 1021, NAS 1022; AN 363, AN 364, AN 365 and AN Plain Nuts

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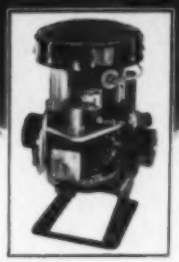

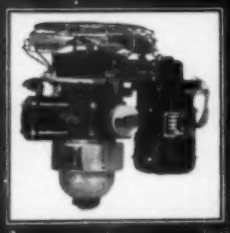
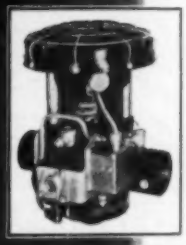
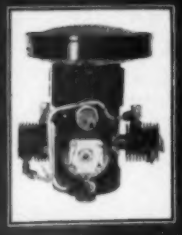

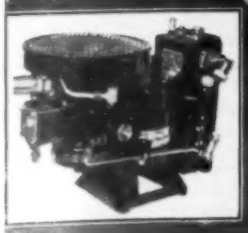
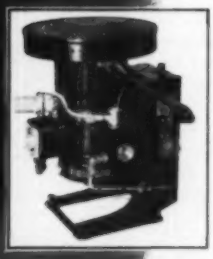

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*Photographs show but 10 of the 36 different Cornelius compressors available.

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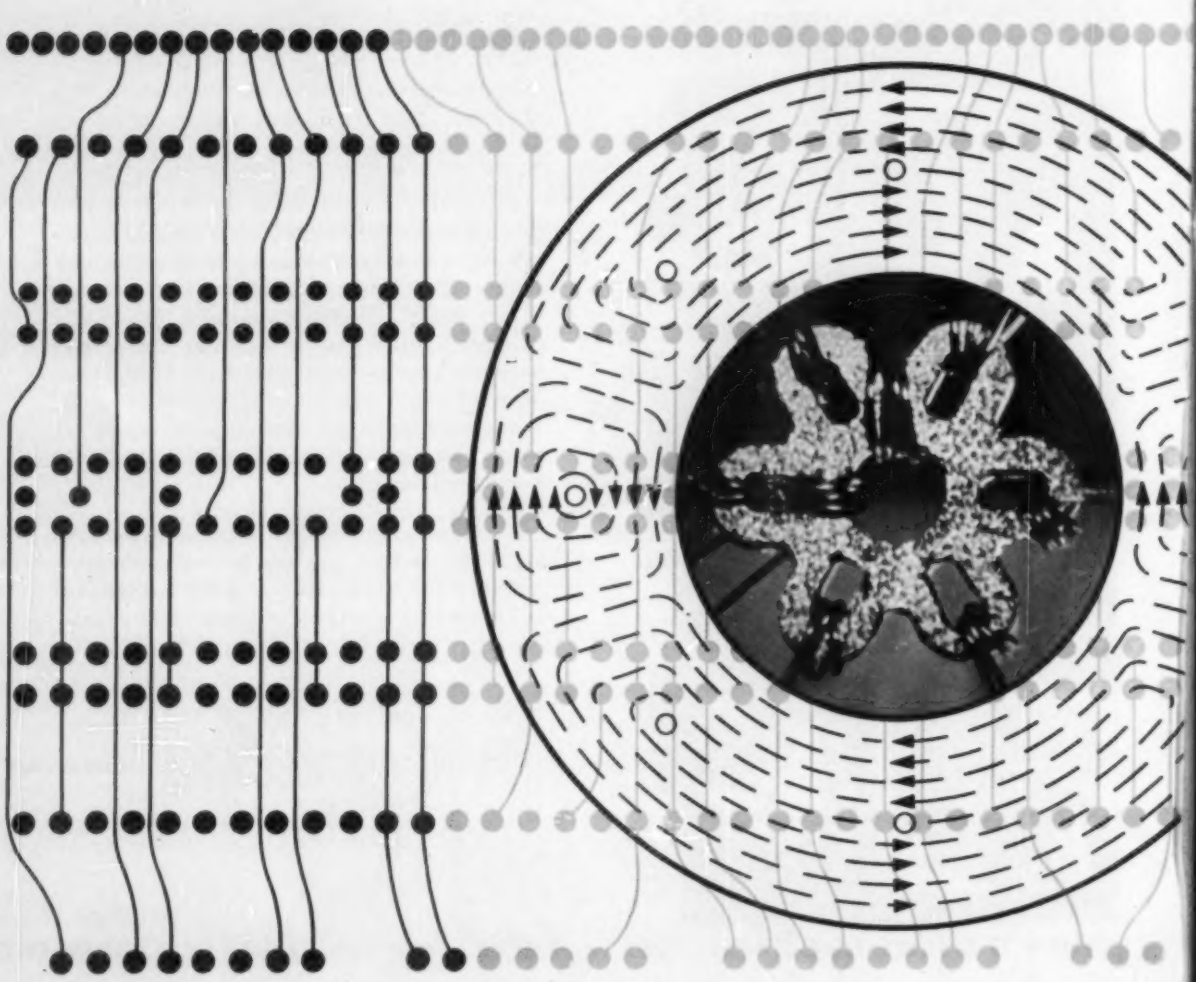
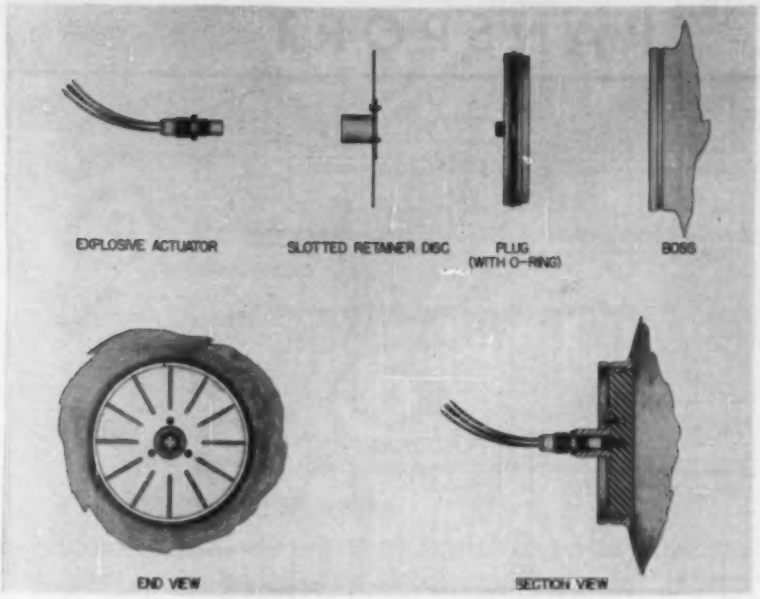




MINUTEMAN THRUST REVERSER details are shown in the chart above.

How Minuteman Releases Warhead

Los Angeles—Minuteman intercontinental ballistic missile thrust reverser designed by Aerojet-General to separate warhead from third stage propulsion precisely at programed burn-out velocity and position is an explosive-actuated blow-out plug, several of which are located in front end of third stage motor case.

Removal of plugs are synchronized with release of warhead hold-downs. Escape of pressure through the ports causes reverse thrust to separate warhead and engines terminating acceleration of warhead.

Shortly after the brief kick of reverse thrust, a chamber pressure drop stops combustion of the solid rocket propellant. Elapsed time from guidance system command to beginning of reverse thrust pulse is about 300 microseconds. There is no nozzle in the reverse thrust port.

Blowout assembly consists of a phenolic plug and an O-ring seal which fit into the port, a radial-slotted steel disk fastened to the plug by three small screws, a retaining ring on a boss in the rocket case and explosive actuator.

Diameter of the plug is smaller than that of the retaining ring to let it pass through the ring during the thrust termination sequence but slotted disk is larger than the retaining ring.

Edge of the disk takes pressure as shear load and has withstood chamber pressures up to 1,000 psi. Detonation of the actuator breaks screws attaching disk to plug and pushes center of the disk outward.

Radial slots allow the disk to deform into a cone with smaller diameter which passes through the retaining ring, permitting plug to escape and reverse thrust to be generated.

Energy requirements of actuator initiator bridges are high enough to prevent accidental firing by induced currents. A 28 v.d.c., 6 amp. firing pulse lasting 50 microseconds is needed for actuation. Filter circuits are available to prevent accidental firing in heavy radio frequency fields.

707 Crash Hearing

Riverhead, N. Y.—Preliminary report from Civil Aeronautics Board structures group investigating the Aug. 15 fatal crash of an American Airlines Boeing 707-120 turbojet transport (AW Aug. 14, p. 39) indicates that the temperatures of No. 1 and 2 engines were considerably higher than temperatures of No. 3 and 4 engine, at time of impact.

This might indicate that the right engines were throttled back as part of a training maneuver.

Investigators reported the engine oil temperature gages indicated that at time of impact the temperatures of engines No. 1 and 2 were about 105C, No. 3 engine's temperature was 70C, and No. 4 was 74C.

The preliminary report, which was part of testimony presented last week at a CAB hearing on the accident, indicated the aircraft's angle of impact was about 25 deg., that landing gear was extended, and that flaps were extended 30 deg.

News Digest

Flight test program will be resumed on the Ryan Aeronautical Co. Vertiplane in September at Moffett Naval Air Station, Calif. Fuselage has been lengthed 18 in. The cockpit will remain open, and an ejection seat has been added for low-level escape. The Vertiplane was damaged when a propeller failed in flight and the aircraft could not be flared out on landing (AW Feb. 23, p. 30).

Re-entry vehicle of Discoverer VI satellite (AW Aug. 24, p. 36) successfully separated according to telemetry information received, but nothing more was heard and search was abandoned after a few hours.

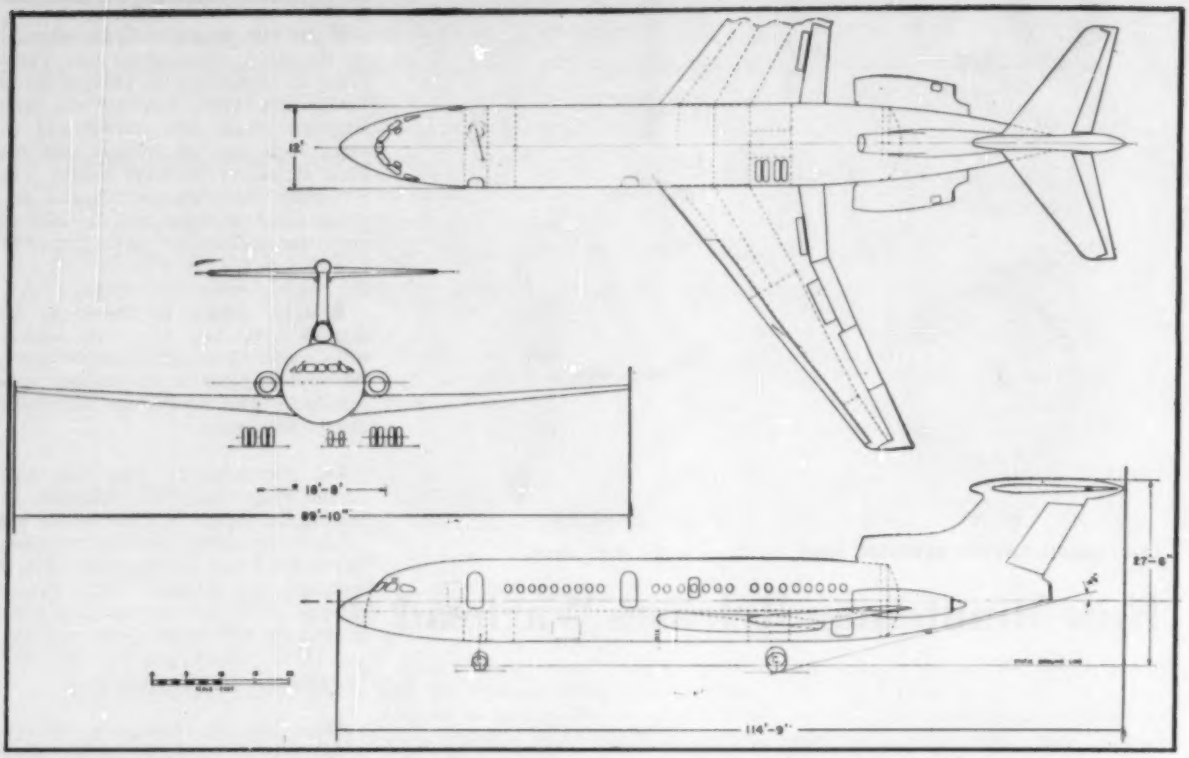
Dr. Alexander H. Flax has been named chief Air Force scientist, replacing Dr. Joseph V. Charyk, who was recently appointed Assistant Secretary for Research and Development. Flax is currently vice president and technical director of Cornell Aeronautical Laboratory. He will begin a one year term as USAF chief scientist in mid-September.

Solar Aircraft Company reported earnings of $13,235,100 for the three-month period ending July 31—down $2,148,000 from the same period last year. Before-tax profits for this quarter were $17,100 compared with $853,200 last year. The decline was attributed to a changeover from projects in the jet engine field to new projects in missiles and gas turbines.

Summers Gyroscope Co. reduced its losses from $4.2 million in 1957 to $1.3 million in 1958. The company, which received substantial support from Atlas Corp. last year in stock purchases and loans with conversion options, now has a backlog of $10 million for orders including Terrier, Tartar, Lacrosse, Bullpup and Quail components.

Space Corp. of Dallas, Tex., has been awarded subcontracts totaling over $400,000 by North American Aviation's Missile Division for equipment to be used in the GAM-77 Hound Dog missile program. Contracts call for production of engine test stands, accessory kits and control cabinets for the air-to-surface missile.

U. S. Army Signal Corps has awarded a $4.9 million contract to Aerojet-General Corp.'s Aeronautics Division (purchased from Rheem Mfg.) for improved SD-2 surveillance drone systems. Initial flight testing of this version is scheduled for early 1960.



DH-121 TRANSPORT designed by de Havilland will have three Rolls-Royce Conway 10,100-lb.-thrust R. B. 163 bypass engines.

Turbojet DH-121 Designed for Economy

De Havilland claims its 75-97-passenger three-jet airliner has 10% seat-mile cost advantage.

By John Tunstall

London—De Havilland claims its 75-97-passenger DH-121, now designed as a 1,000-mi. short-haul turbojet transport, has a 10% seat-mile cost advantage over competing aircraft.

Through dropping the full load range from 1,800 to 1,000 mi., the gross weight of the DH-121 has been reduced from 135,000 lb. in the original specification to 105,000 lb. The transport now is to be powered by a smaller, specially-designed high-ratio bypass engine of 10,100 lb. thrust—the Rolls-Royce Conway R. B. 163.

Rolls-Royce told AVIATION WEEK it proposes to continue development of the larger engine originally specified for the DH-121, for a Sud Aviation Caravelle version. A company spokesman declined to say whether both engines may use the same common parts.

Seat-Mile Cost

Discussing details of the DH-121, de Havilland Technical Sales Manager Peter Hall claimed that with a cruising speed of 600 mph. and accommodation for 75-97 passengers the aircraft represented the ultimate in subsonic short-haul aircraft. Seat-mile costs, using standard Air Transport Assn. methods, were as low as 1.15 cents over 1,000-mi. stages with 97 passengers.

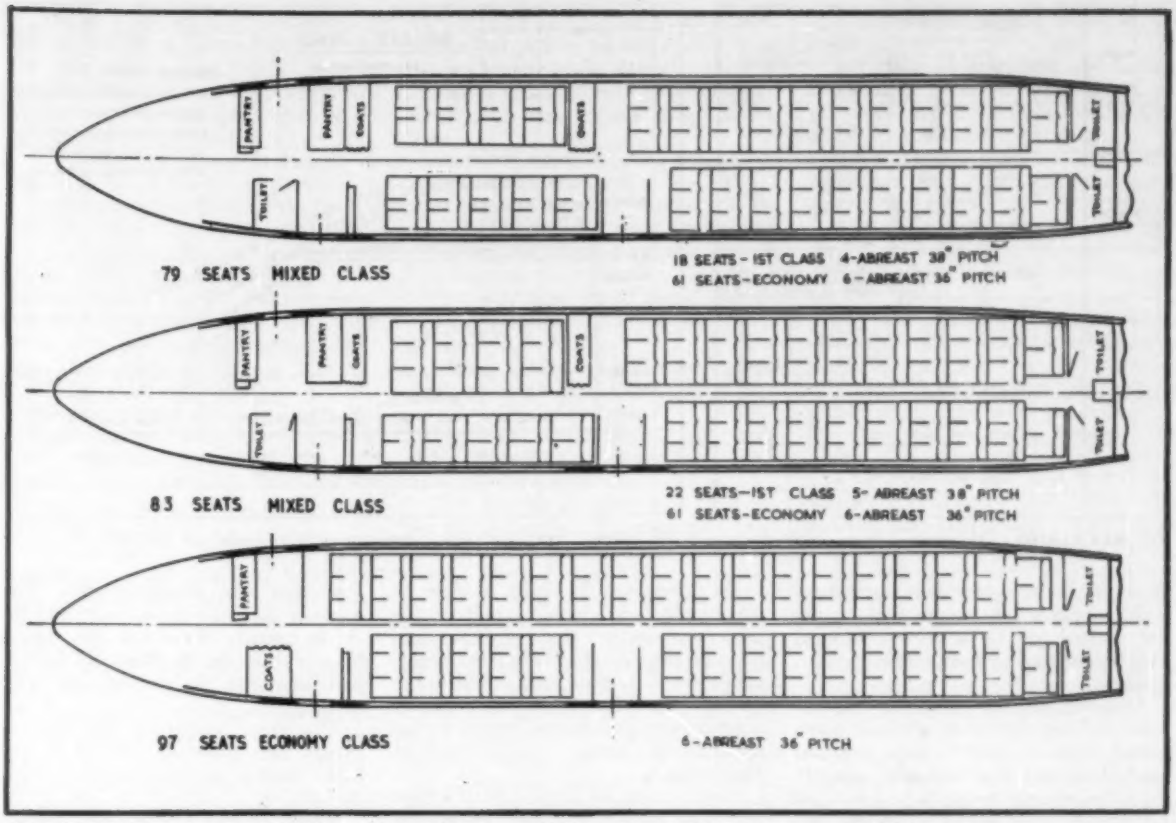
De Havilland believes this to be nearly 10% better than that offered by other aircraft. Mostly this is attributed to the fact that de Havilland has not suffered the compromise involved in combining short and medium haul operations. In fact, de Havilland says, improving the current DH-121 design has led to better operating economics than it had originally hoped to get from the much larger aircraft originally specified.

But de Havilland attributes at least a 4% advantage in DH-121 operating economy to the use of three engines, which is possible by mounting them in the rear of the fuselage. A three-engined configuration balances cruising thrust with critical takeoff requirements, de Havilland says, and three engines can be arranged to operate at their design point to provide the cruising thrust, while two just meet the engine-out thrust requirement at the critical point during takeoff at 6,000 ft.

Power Factor

Without accepting a heavier wing or compromising the takeoff performance, a twin-engined installation large enough to satisfy single-engine takeoff is overpowered on the cruise, de Havilland says, while a four-engined installation overpowers the takeoff.

Locating the thrust in the tail, besides reducing cabin noise levels, leads obviously to the structural and aerodynamic advantages of a clean wing with full-span, uninterrupted flaps. It also minimizes the structural hazard associated with blade and disk shedding by



SEAT-MILEAGE costs for the DH-121 are projected as low as 1.15 cents over 1,000-mi. stages with 97 passengers.

On Short Hauls

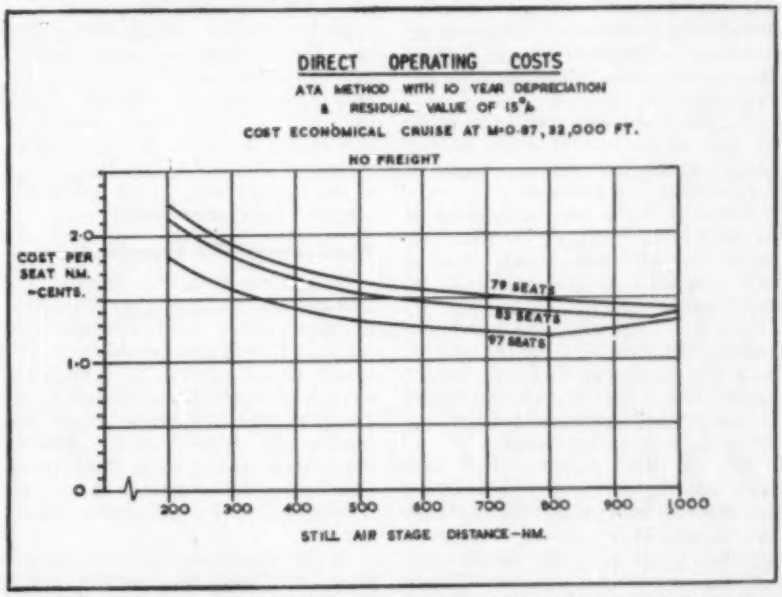
placing turbine disk planes aft of the pressurized cabin and clear of the fuel tankage, de Havilland says.

Other points of the engine placing cited by Hall are:

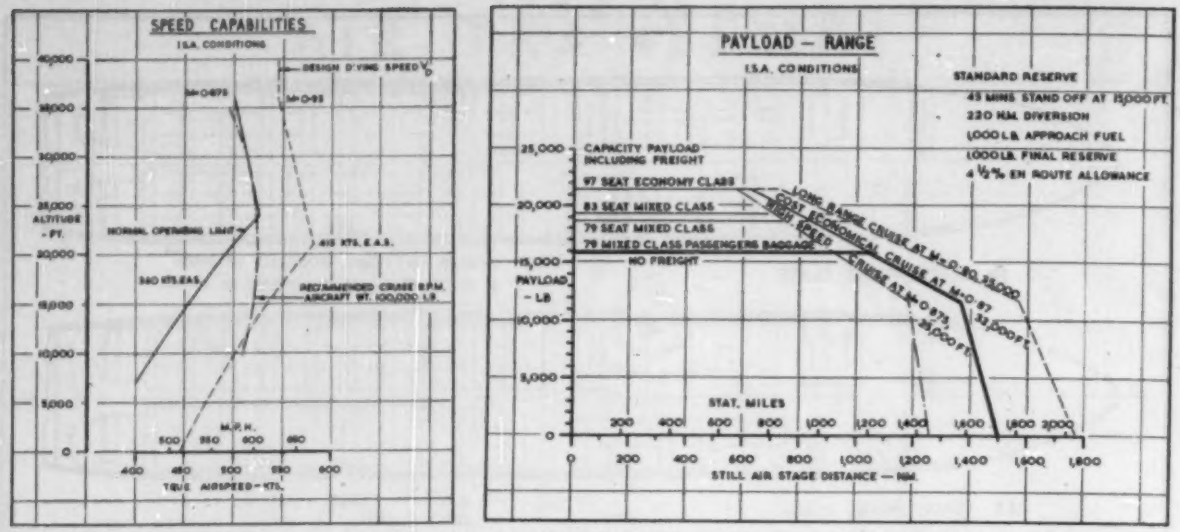
- **Primary structure** is freed from jet noise fatigue loading.
- **Reversed thrust** is usable for braking without tail buffeting. Only the outer engines have reverse thrust. All engines have suppressors.
- **Thrust asymmetry** during engine-out is minimized.
- **Reverse thrust** efflux is unable to get sucked into intake of adjacent engines causing dangerous temperature rise.
- **Vulnerability to engine** ingestion of surface debris is reduced by high position, plus further protection afforded by flaps.
- **Influence of wing downwash** ensures axial intake flow despite high angle of attack assumed by pods in certain flight regimes.
- **Proximity of engine grouping** simplifies maintenance, shortens over-all systems runs.

De Havilland admits to only one minor disadvantage of the layout—a restricted center of gravity movement which might make part load distributions more critical. The extra weight of the fuselage, due to engine weight and thrust loading, was canceled by the improved structural efficiency of the wing, Hall said.

Neither has the center engine introduced any significant engineering problems. The engine is cantilevered from bearers extending from the rear of the fuselage. By locating it aft but at roughly the same height as the outboard engines, de Havilland says that it is not difficult to service or remove. Access to the center engine is through folding



DIRECT operating costs for the DH-121 are based on standard Air Transport Assn. methods.



DE HAVILLAND performance charts show the speed capabilities (left) and payload-range capabilities (right) of the DH-121.

doors at bottom of the rear fuselage.

Members which secure the engines are stressed to 12g to prevent forward engine displacement in event of crash landing.

Commenting on claims that the aircraft will operate with seat-mile costs better than on current turboprop aircraft, Hall said that turboprop aircraft were "mistakenly trying to be jets," and instead of using improved engine specifics to lower costs, there was an abortive tendency to fritter away the advantages in chasing the jets for speed, without significantly closing the gap.

Market Potential

De Havilland estimates of the world market potential for the DH-121 are based mainly on replacement of existing Vickers Viscounts and Convairliners. It is aimed particularly for regional operators on networks in western Europe, the Middle East, southeast Asia and Australia.

De Havilland does not know what its share of the market might be, but one spokesman put the company's expectations at 300 minimum.

The aircraft also has a sales potential in the United States, de Havilland believes, and in South America, and it will soon start working vigorously on the market.

Above 23,000 ft., the maximum cruising rating of the DH-121 coincides with the maximum designed cruising speed. Below that height the aircraft is not stressed to utilize full cruising thrust capacity of the engines.

But at these altitudes, Hall said, tests with the de Havilland Comet flying at speeds below those intended with the Douglas DC-9, the ride was noticeably rough and in de Havilland's opinion unacceptable for commercial operation.

De Havilland does not propose to use bonding or chemical milling any more extensively than it has used them on the Comet. There is no honeycomb paneling. Structural details in the fuselage will follow fairly closely Comet practice with the frames riveted to the skin through doublers and notched at the stringers.

The cutouts are framed by doublers and door cutouts will have chemically milled surrounds. Stringers and doublers are reduxed to the skin.

Spokesmen for both British European Airways and de Havilland agree that a specification conflict between them was never concerned with the passenger capacity requirement but with seating density. It arose from an obsolete definition used by the airline in specifying the seating layout .

BEA's original specification called for a 75 "standard class" seating layout, and an aircraft capable of taking the full complement to Moscow (1,800 stat. mi.). De Havilland's interpretation of this layout led to a four-abreast configuration in the first-class section of the fuselage whereas the airline had intended five-abreast seating.

Requirement Re-Examined

As a consequence the fuselage, and thus the aircraft, was larger than BEA intended. This scale situation was aggravated by engine availability. The bypass engine offered by Rolls-Royce was under development for other applications and its initial thrust was considerably in excess of the DH-121 requirement based on a three-engine, rear-fuselage configuration. It had also the promise of considerable thrust stretch.

As the aircraft was still in the project stage, BEA and de Havilland jointly decided to re-examine the market requirement and decide whether there was any justification in exploiting the thrust capacity of the R.B. 143 engines by accepting the de Havilland project, and increasing the payload and range specification.

The gross weight of the DH-121 project then stood at 135,000 lb. and had a built-in stretch potential of 150,000 lb.

Result of the new market analysis, however, confirmed the correctness of the original BEA assessment and the joint decision was finally taken to stay with the original specification as conceived by BEA but to redesign the aircraft for short-haul operation and install smaller engines. This redesign was called for, owing to the unfavorable effects of the reduced size on operating economics.

Scaled-Down Version

Before deciding on a considerably scaled-down version of the R.B. 143 bypass engine, de Havilland examined a number of other engine types and configurations, among those rejected being a trio of Gyron Juniors.

The new payload-range characteristics still enable the aircraft to reach Moscow but with a reduced payload.

The fuselage is a relatively heavier construction due to the fact that the weight of the engines increases the fuselage nodding loads. In comparison with these loads the stress increments due to the axial thrust load are insignificant.

The multi-spar wing, although entirely new, will stay with skin-reduxed stringer construction.

Wing section is so shaped that sweep angle is effective over the whole span. Operating limit Mach number is 0.875 above 24,000 ft. and maximum economy speed Mach number is 0.87 at

32,000 ft. Flaps are double-slotted and during deflection automatically droop the wing leading edge.

Tail plane is all-moving with geared elevator and is the same type as developed for the Sea Vixen.

The minimum skin gage throughout the aircraft is 18-SWG. The wing runs continuously skinned from tip to tip, the wing skin between front and rear webs serving as the pressurized floor of the cabin. It is joined to the fuselage by duplicated twin frames. Forty per cent span wing center section has three webs, the outboard sections have two. Sweepback is 35 deg. and the thickness chord ratio 10%.

Ailerons are in two parts with the inboard sections being used only for cruise. The outer 80% of the wing leading edge can be mechanically dropped and the flaps run uninterrupted over the full span.

Lift dumpers in the form of hinge panels remove lift from the flaps after touchdown in order to enable full wheel brake capacity of the aircraft to be developed.

The aircraft will also have conventional air brakes but it is expected that the rear engine configuration will permit reversed thrust braking. Tests on the Comet have revealed that with ordinary wing engine installations reverse thrust air braking introduces severe air buffeting.

Company Undecided

The company appears to be undecided whether to duct the fuel lines along the fuselage internally or externally.

To lower depth of the wheel well, the nose wheel is offset and retracts transversely. The main wheels retract into an extension of the unpressurized wing cutout in the fuselage, the hinge system being arranged so that the wheels pivot through a further 90 deg.

Hydraulic system for the surfaces, the flaps and the electrical power supply are all triplicated. Flaps, ailerons and elevator systems are each powered by triple irreversible boosters and each system has its own hydraulic pump, there being one pump on each engine. The triple boosters in each system are continuously loaded and following the failure of one booster the remaining two boosters for that particular control system are capable of accepting any maneuver demand. All nine boosters are closely mounted to their respective surfaces, an arrangement which has led to some weight saving. Each engine also drives a constant speed alternator. Beyond this triplication there is a further emergency electrical motor to power the hydraulic system.

Servicing of the aircraft has been facilitated by locating the hydraulic bay in the engine compartment together with air conditioning and pressurization equipment, and by placing the electrical bay in the nose of the aircraft.

Instrumentation includes diagramatic displays of the electrical and fuel systems.

The company is planning a much less destructive test program of the DH-121 than on the Comet, because of the availability of its Comet experience, although the fatigue test program will culminate in the testing to destruction with a simulated cyclic flight program of a complete aircraft in the water tank at Hatfield.

This specimen will utilize major components which have already been used in the static test program.

The DH-121 will pioneer fully automatic flareout and all-weather operations when it enters service in late 1963.

The landing system, developed by the Blind Landing Experimental Unit at the Royal Aeronautical Establishment, Bedford (AW Nov. 3, 1958, p. 76) retains a largely standard Smiths autopilot and flight system with conversion couplers fed with height information from a radio altimeter accurate to plus or minus two feet. Automatic lateral and azimuth control in this system is derived from a magnetic leader cable on the ground or from a new type ILS (instrument landing system) equipment using a twin aerial system with an accuracy better than plus or minus 20 ft. But de Havilland says that for an initial period, azimuth and lateral control of the aircraft will be left to the pilot.

De Havilland says it is satisfied the best policy is to introduce blind landing in two stages, starting with automatic flare, particularly as the system lends itself to this separation. This attitude appears to be supported by the fact that the ILS equipment currently available is not sufficiently accurate on its own to provide a satisfactory azimuth reference and the magnetic leader cable needed is open to the objection that it could not be made available at airfields with short approaches.

But Standard Telephone and Cables, Ltd. has at an advanced stage of development an ILS system using a twin aerial array which greatly increases the accuracy of the azimuth signal and would cut the length of leader cable needed to 1,000 ft.

A spokesman for the company told AVIATION WEEK that this system could easily be available for the DH-121 service date if required.

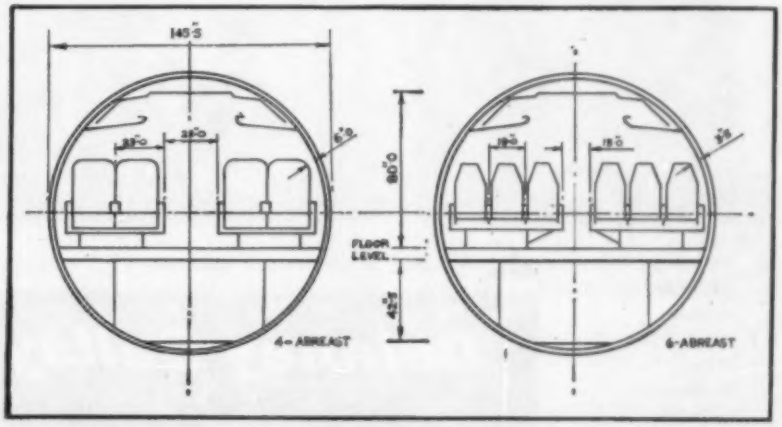
Standard Telephones has also developed the radio altimeter used in automatic flareout. By 1963 the company will have commercially available a transistorized version of the current instrument which cuts the weight from 45 to 2 lb. The company's technical director, M. Settelen, said the design which the company had registered with Aeronautical Radio, Inc., was considered by Arinc to be ahead of anything of its kind in the world and Arinc was currently circulating the specification to world airlines and aircraft manufacturers.

The radio altimeter was originally developed for a low-level bombing application and is accurate to a height of two feet.

It measures height and rate of change of height signals which are converted by couplers on the autopilot into throttle and elevator movements.

A decision to triplicate the autopilot (triple channels) is one which may be altered in light of experience. Some authorities believe a better system would be a twin-channel autopilot monitored by an entirely different system.

A British European Airways spokesman told AVIATION WEEK that it was intended to use the auto-flare extensively during visual landing operations as well as in instrument approach conditions in order to build up experience of the equipment. Automatic azimuth and lateral control may not be introduced until 1970, the spokesman said.



CROSS-SECTIONS show configurations and dimensions of four-abreast and six-abreast layouts.

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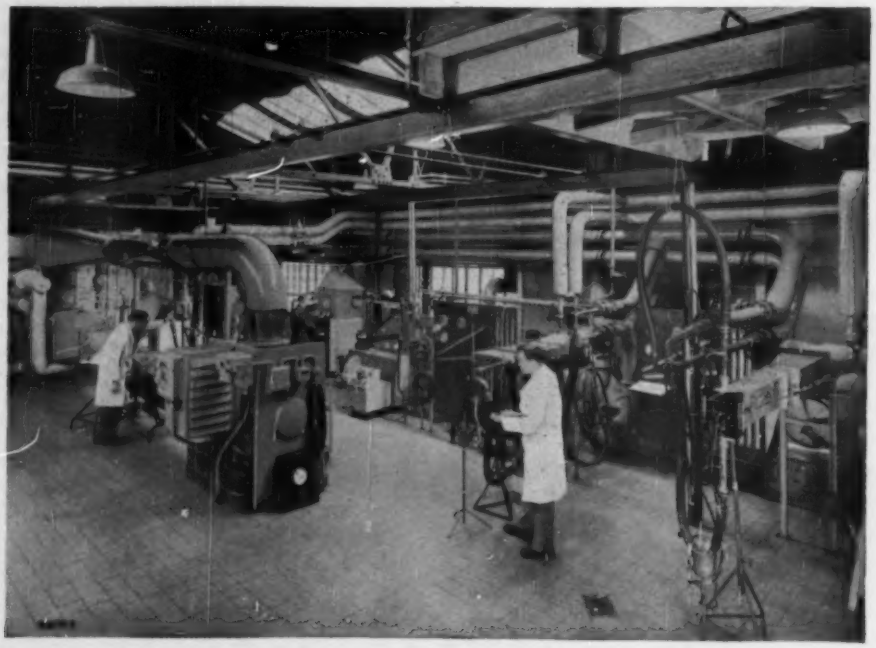

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Record of 707 Tops Piston Transports

By L. L. Doty

Washington—Boeing 707 turbojet transport, after 10 months of operation in scheduled service, has achieved a performance record superior to that of the majority of the four-engine piston-powered aircraft now operating in trunkline and international scheduled service.

Despite rumors to the contrary that have been coupled with talk that American Airlines is to be grounded by the Federal Aviation Agency for failure to recognize civil penalties filed against it, there has been no move on the part of the agency to take such drastic action as the grounding of any aircraft in airline service. Only recent instance of removal of an aircraft from service was the recent voluntary withdrawal of the Canadair 540 from Allegheny Airlines' operations during the testing of engine bearing malfunctions (AW Aug. 24, p. 45).

707 Record

Actually, the performance record of the Boeing 707 virtually eliminates any possibility of its being grounded by the FAA at present. Here are a few extracts from the aircraft's record as of July 31:

• **Pan American,** which began its service in October, had operated its fleet a total of 13,223 hr. and flown 484 million revenue passenger miles in its transatlantic operation by the end of July. The carrier began service on the route with two Boeing 707s, now operates six of the turbojets.

• **Utilization of the aircraft** is 8.88 hr. Total of 64,000 engine hours of flight had been accumulated by the end of July.

• **Five in-flight engine shut-downs** due to malfunctioning of some components have been experienced by the airline. This gives the engine a record of 13,000 engine hours per engine shut-down.

• **American Airlines also has** experienced five engine shut-downs which, it reports, represents a reliability factor three to four times greater than that recorded for the Douglas DC-6.

• **American Airlines recorded** 15 interrupted Boeing 707 flights or unscheduled landings because of mechanical reasons during its period of operation with the fleet—Jan. 25 through July 31. This dependability rate, the carrier says, is twice that of the DC-6.

• **Trans World Airlines** attained a remarkable operating record with its fleet of Boeing 707s. During the five months its fleet of 15 707s have been in scheduled service, 99.8% of scheduled miles had been completed—the carrier had canceled only two flights out of 886 by the end of July. Utilization reached nine hours and turbojet engine hours have accumulated to a total of 43,380. The airline has had two engine shut-downs, neither of which required an engine removal.

Demands for Grounding

To some extent, rumors concerning the grounding of aircraft stem from demands for such action by Rep. Steven B. Derounian (R.-N. Y.) (AW July 27, p. 53) and recent moves by the FAA to tighten safety regulations governing airline operations for both piston engine and turbine-powered aircraft. Actually, the five major rules either now in effect or in the mill which are considered the most drastic revisions of former rules, pertain directly to the cockpit area and do not necessarily affect airframe and engine performance.

Nevertheless, the effect of the new rules has spilled over into other areas and has resulted in a stiffening of FAA enforcement proceedings in the maintenance and overhaul fields. A number of airline engineering officials have challenged the need for more stringent FAA measures on grounds that airline operating manuals establish minimum standards higher than those required by FAA.

A series of violations filed against American Airlines has bred a rash of rumors ranging from threats by the FAA to ground the airline to reports that American was willing to pay out thousands of dollars in civil penalty fines rather than conform with FAA maintenance standards.

American Case

Here are the facts in the case as told to Aviation Week by top-level officers of American and the FAA:

• **American, since the first** of the year, has had 29 violations filed against it by the FAA, nine of which were civil penalty fines. The violations did not necessarily pertain to Boeing 707 or Lockheed Electras, and the number of violations is not excessively large for any large carrier.

• **Corrective action** on the violations did not immediately follow notification of the violations, and the FAA did send a letter to American summarizing the issues at stake.

• **American President C. R. Smith** immediately ordered an investigation of the violations and met personally with FAA Administrator Elwood R. Quesada at FAA headquarters here to discuss the problem.

• **Top-level legal officer** of American met with FAA legal officials to iron out the differences that existed between the agency and the airline.

• **No reason for the delay** in following up on the violation orders has been given.

At present, American has indicated that it concurs with the violations filed by the FAA and will take immediate action to correct the discrepancies as soon as its investigation is completed. According to one American spokesman, none of the violations affected the airworthiness of the aircraft involved.

Major Problems

In connection with its Boeing 707 operation, these are the principal problems that have accompanied the introduction of the 707s—not problems involved in the FAA violations proceedings against the carriers—and which have drawn public and congressional criticism of the plane:

• **Hydraulic power.** Casings of a few hydraulic pumps have fractured as the result of high surges of pressure. Under the same type of pressure, some pump seals also opened until a bypass line was installed on all pumps to stop the incidents. At the same time, filters in the hydraulic lines began to shred, contaminating the lines. The fix was the installation of metallic filters. No incident with the hydraulic system has produced an emergency situation.

• **Water pumps.** Newly-designed circuit breakers in the power supply of submerged pumps in the main water tank put a stop to periodic operating failures of the pumps.

• **Landing gear.** The freezing of the bearings on a landing gear wheel caused the loss of the brake assembly on the wheel during a takeoff. Landing at destination was made without incident. Continuous inspection of bearings has uncovered no additional bearing problems. Following failure of a snubber on the main gear of Pan American's Boeing 707 (AW July 27, p. 53), American has constantly inspected snubbers and related assemblies without finding any malfunctions.

• **Air conditioning.** Power kickouts in the air conditioning system have drawn complaints from the crews. In addition, there have been passenger complaints as to the poor air flow in the cabin. The problem has been solved to a substantial degree by reworking the air ducts to allow a freer circulation of air.

Currently, there are 41 Boeing 707s in operation. To cope with in-flight inspection requirements of the turbojet aircraft, FAA arranged for the training of its flight operations inspectors to [illegible] and the USAF Strategic Air Com-

EXPANDING THE FRONTIERS

OF SPACE TECHNOLOGY...IN

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mand's KC-135 training course at Castle AFB, Calif.

To date, 14 FAA inspectors have been scheduled to complete the 11-week proficiency course on the KC-135 tanker version of the 707. The training program was adopted so that inspectors could better evaluate the competency of commercial jet pilots as well as provide them with training in the over-all operational problems associated with today's jet transport aviation.

Strengthen Relationship

Quesada told AVIATION WEEK that the program would strengthen the "relationship between inspector and the inspected so that inspections could be conducted on an arm's length basis." The course, he said, covers six weeks of ground school and five weeks of flying instruction.

All instructors receive proficiency checks at the completion of the flight phase.

Submit Details

In addition, Quesada has introduced another rule which calls for carriers to submit details of their flight training programs for FAA approval. In other areas, Quesada has proposed rules which will require copilots to qualify on all aircraft to which they are assigned, establishes an age limit for pilot retirement or for being indoctrinated into jet flight (AW July 6, p. 33) and prevents persons with a history of heart ailments from holding a pilot certificate.

FAA Asked to Probe Jet Noise Complaints

Washington—New York's congressional delegation last week agreed to send a letter to the Federal Aviation Agency in which it plans to request action on the jet transport noise problem following testimony by John T. Clancy, president of New York's Queens Borough, location of the New York International Airport.

Clancy told the House Foreign and Interstate Commerce Committee that noise complaints have been more "pathetic" than ever since the advent of the summer "open window" season and the considerable increase in turbojet transport schedules.

The committee is investigating the powers and functions of federal agencies over the operation of aircraft.

In July, the Port of New York Authority received 113 complaints of which 65 were about jet noise specifically. In July, 1958, the Port Authority received two noise complaints. There were 34 in June of this year, none in the same month of 1958.

SHEREMETYEVO AIRPORT control tower is makeshift or temporary affair (tables are clustered to form console base and alarm clock is placed before controller). Radio equipment to left of controller's panel probably consists of a pair of mobile VHF transceivers. Tower windows appear to be of poor grade; note distortion of Il-14 transports and tarred lines on ramp.

AEROFLOT Tu-104B jet transport makes daily flights into new Sheremetyevo Airport.

Moscow Opens Third Civil Airport

Moscow—The newly-opened third commercial airport at Sheremetyevo will become a major terminal for trunk routes into Moscow as soon as passenger facilities are completed, according to manager V. A. Borisov.

Located 16 mi. northwest of Moscow near the Moscow-Leningrad highway, the Sheremetyevo field is described as "one of the best in the USSR both from the standpoint of size and equipment." It is one of over 90 airports scheduled for construction or reconstruction under the Seven-Year Plan (1959-1965).

Like Bykovo Airport, Sheremetyevo is a combination military-civil field and has Badger bomber units based across from the main terminal in an area restricted to foreigners. The runway is reported to be about 15,000 ft. long and is built in the standard Russian manner with precast concrete sections.

Aeroflot is already operating seven Moscow-Leningrad, 100-passenger, twin-jet Tu-104B flights into the new field daily. Tu-104B flights to Kiev and Tbilisi as well as piston-engine Il-14 flights to Riga, Vilnius, Stalino, Arkhangelsk and Minsk will use Sheremetyevo shortly.

The airline has put its best piston-engine transport—the Il-14—on Moscow's new inter-airport shuttle service. An Li-2 (Russian-built DC-3) first flew the "air taxi" route when it opened Aug. 11. The Il-14 makes the full circle from Moscow's main Vnukovo terminal to the new Sheremetyevo Airport, on to Bykovo Airport, and back to Vnukovo in less than an hour.

The Marines are landing with COLLINS SSB COMMUNICATION

On February 16, 1959, Collins received a contract from the Marine Corps for production quantities of AN/TRC-75Transceivers. Sixty-eight days later the first of these jeep mounted, high frequency communication stations were on their way to Quantico, Va. Modular design of similar Collins equipment speeded adaptation to Marine Corps requirements—saved research and development time and expense.

The AN/TRC-75 can be easily operated by non-technical personnel. Nominal output is 1 kw PEP, with 28,000 channels in the 2 to 30 mc range. It is completely compatible with the Navy's URC-32 500 watt transceiver, as well as the Air Force's ARC-58 airborne 1 kw transceiver and FRC-44 ground system, all designed and built by Collins.

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Monroney Urges MATS Policy Changes

Washington—Development of modern cargo aircraft for both commercial and military use and transfer of routine logistics from Air Force's Military Air Transport Service to the civil airlines was urged last week by Sen. A. S. Mike Monroney (D.-Okla.).

In a Senate speech, Sen. Monroney, chairman of the Aviation Subcommittee of the Senate Commerce Committee, called for a fresh appraisal of military air transportation policies in the interest of a common effort to develop maximum military strength at minimum cost.

To accomplish this, Sen. Monroney made these recommendations:

- **Orderly transfer of the routine** logistic function from the MATS fleet to civil carriers, to the extent of their present capacity to perform it.
- **Comprehensive program to** develop modern cargo aircraft and to encourage the civil carriers to procure them to provide the capacity required to perform the air logistic function in peace and permit its expansion in an emergency.
- **Modernization of the MATS** strategic transport fleet in terms of its primary hard-core mission, not in terms of its airline mission.

Sen. Monroney noted the growing controversy over role of MATS, its need for new equipment and its relation to civil air transportation. He said MATS' primary "hard core" responsibility is, or should be, immediate provision of its available airlift for transporting military personnel and equipment to overseas points in the event of war or military emergency.

MATS secondary responsibility is to provide routine overseas air logistics, Monroney said. A portion of this involves missions of a special nature, the movement of over-sized, classified or explosive cargo or movement to destinations involving unusual risk. Monroney added, however, that by far the greater part of such movements are no different from those handled by civil carriers in their daily operations.

"It is therefore not surprising," he said, "that once the decision is made to handle this routine traffic primarily in MATS planes, that MATS has become an airline, the biggest in the world, with published schedules, stewardesses, and planes identical to those flown by its civil competitors."

Sen. Monroney said there has been a growing conviction both in Congress and in the Defense Department, that the peace-time airline operation of MATS is in direct conflict with its ability to discharge its primary responsibility in an emergency.

He said that this feeling stems from the fact that the amount of traffic being carried on MATS planes requires a high rate of utilization, and that, at any given time, the great majority of its planes are scattered all over the world performing routine chores.

Not only must its planes be recalled in the event of an emergency and necessary maintenance performed before MATS can conduct any large scale movement of troops, Monroney said, but some arrangement also must be made on a crash basis for commercial aircraft to take over routine air logistics on which overseas units depend.

If MATS was to rely on commercial carriers for the routine movement of military passengers and cargo, Sen. Monroney said, it would permit a low normal rate of utilization of aircraft and ensure their immediate availability in the event of an emergency without the disruption of routine air logistics, which the civil carriers would continue to furnish.

One of the biggest problems, he said, is the lack of modern cargo troop-carrying aircraft. Monroney added that, at the end of Fiscal 1960, MATS will have 442 aircraft in its transport fleet, 191 of them obsolete passenger aircraft. He said that, of the remaining cargo aircraft, only the Douglas C-133 turboprop transport, of which MATS will have 33, is reasonably modern. The bulk of cargo and troop carrying capacity of MATS is provided by 218 Douglas C-124s, an aircraft first designed in 1947, first produced in 1948 and on which production was terminated in 1955.

Sen. Monroney said a similar situation prevails in the civil airlines—they have adequate passenger capacity to immediately assume movement of substantially all military passenger traffic, but they have no modern cargo aircraft. Therefore, Monroney said, just as MATS unquestionably must have more modern cargo aircraft for its "hard-core" emergency responsibilities, the civil air carriers must have more modern cargo aircraft to fully perform the routine air logistics function.

Commercial carriers cannot be expected to purchase significant quantities of economical long-range commercial cargo aircraft to greatly expand their capacity while 40% of their present capacity goes unused, nor can they purchase the quantities of such aircraft required unless they receive assistance in financing their purchase, Monroney said.

Such assistance, in the form of a government guarantee of private loans, secured by the aircraft, could be conditioned on both the suitability and availability of the aircraft for military use in an emergency requiring airlift beyond the capacity of the MATS fleet, he said.

Sen. Monroney charged the Air Force not only opposed the effort to increase the funds earmarked for procurement of commercial airlift, but proposed to decrease the amount to the level actually spent for that purpose last year and conducted a vigorous lobbying campaign on that appropriation item.

"The Air Force," he said, "also renewed a request to procure, not cargo aircraft, but converted jet passenger planes, whose usefulness for the hard-core mission is at best dubious, but whose usefulness for de luxe passenger service is unquestioned."

He also charged that progress on the bill to facilitate purchase of cargo aircraft by civil carriers has been stalled by the Secretary of the Air Force.

SAS-Thai Agreement

Government of Thailand has approved a cooperative agreement between Thai Airways Co., Ltd., the national carrier, and Scandinavian Airlines System in forming a new company, Thai Airways International (AW June 15, p. 38). SAS will become a minority shareholder and will make available a number of Douglas DC-6 or DC-6B aircraft to Thai Airways. SAS also has negotiated sale of three Thai Airways Lockheed Super-G Constellation transports to Guest Aerovias, under new agreement.

JAL Drops 707 Plan

Tokyo—Japan Air Lines in a surprise move last week told Continental Air Lines in a brief cable that it was dropping plans to lease a Boeing 707-120 turbojet transport from Continental as a means of entering Pacific jet competition this year (AW Aug. 17, p. 43).

No explanation was given by Japan Air Lines for the sudden reversal of its decision and cancellation of plans to lease the 707 that would have permitted it to begin jet service between San Francisco and Tokyo early this fall. Pan American has scheduled its Boeing 707 transpacific service to begin Sept. 5. Japan Air Lines has four Douglas DC-8s scheduled for delivery in May, 1960.

Contiaental is about to accept delivery of the Boeing involved—the last of its present order. The carrier plans to explore other leasing possibilities in a move to lighten its available seat capacity during the relatively low winter traffic season.

Northwest Electras to Fly Coast to Coast

Northwest Orient Airlines' long-range Electra turboprop transports will begin scheduled service tomorrow, flying nonstop daily between New York and Seattle/Tacoma. Chicago, Milwaukee and Minneapolis/St. Paul also are scheduled to receive inaugural Northwest Electra service. Northwest's 72-77 passenger turboprops are the first extended-range Electras to begin airline service. The long-range Electra's gross weight is 116,000 lb., compared with 113,000 lb. for the previous models. Fuel capacity is increased by 1,060 gal. to 6,420 gal. Northwest says it can operate Electras economically on the 2,400-mi. New York-Seattle run as well as on the 360-mi. Minneapolis-St. Paul segment.

PanAm Begins 707 Polar Flights Using Intercontinental Jet Version

First scheduled service with the Boeing 707-320 Intercontinental jet transport began last week as Pan American World Airways inaugurated U.S. West Coast-London polar route flights with the plane.

The jets will fly twice-weekly polar round trip schedules, one of them Los Angeles-San Francisco-London and the other San Francisco-Los Angeles-London. Scheduled times, including a fuel stop at Goose Bay, between San Francisco and London are 11 hr. 20 min. eastbound and 13 hr. 15 min. westbound.

Pan American's 707-320s will carry 139 passengers, compared with 111 passengers on its smaller 707-120s now flying the North Atlantic and to South America. Configuration of the Intercontinentals is 111 economy, 28 de luxe. The 320s also are scheduled to begin transpacific service with Pan American this week.

Introduction of jets on the U. S. West Coast-Europe polar route gives Pan American a new and important edge in a market that apparently has been spread a little thin in the last two years. Scandinavian Airlines System pioneered the route with first service in November, 1954; Pan American and Trans World Airlines began flying it in the fall of 1957.

Air France recently received rights over the polar route under terms of the new bilateral between France and the U.S. (AW Aug. 10, p. 39).

Two other foreign flag carriers—British Overseas Airways Corp. and Lufthansa German Airlines—have rights on the route but neither has shown great enthusiasm for beginning service in the near future.

SAS seems to have been holding its own up to now, despite the competition of the two big U. S. airlines. While the other carriers have cut back schedules from a summer-1958 peak, SAS maintains the eight round trips a week frequency it reached last year.

Pan American started with four flights a week, went to daily service in the 1958 summer season, and has cut back this summer to three flights a week.

TWA began with two weekly flights, went to four a week in 1958, and this year is back to two round trips once more.

The Scandinavian carrier reports an over-all load factor on the route of about 68% to July, 1958, and a very slight reduction since that time. Pan American's 1958 load factor on the route was 58%. TWA says its average yearly load factor on the polar run has been "consistently below" the load factor on TWA's international routes overall.

Both Pan American and SAS have been using Douglas DC-7C equipment on the route, while TWA flies the Lockheed 1649A Constellation. TWA is unlikely to put jets on the run this year. Its present target date for transatlantic jet service is some time late this year, and polar jet service probably will come later. SAS expects to put its first Douglas DC-8s into service next April, so this would be the earliest it could match the polar jet competition.

Air France expects to begin service on the North Atlantic next January with the first 707-320s with an order of 17. Polar service to the West Coast is planned next spring, and the jet undoubtedly would take over this route.

Pan American expects to receive its third 707-320 this week. By some time next January, the airline's Atlantic Division will probably be in full-scale 320 operation with 11 of the jets; its Pacific-Alaska Division probably will have four of the planes. Total order is 17. The airline expects to get the first of 17 DC-8s in December. It also has arranged to buy six of TWA's Intercontinental Boeings, and TWA has an option, which expires Sept. 30, to take over PanAm's six 707-120s.

BOAC Group Studies Supersonic Airliners

London—British Overseas Airways Corp. has set up a supersonic transport committee to study the economic, technical and operational implications of supersonic airliners.

Engineers, medical men and sales representatives make up the group, which is headed by a senior BOAC pilot, Capt. E. C. Miles.

According to D. J. N. Wakeling, BOAC senior research development engineer, it is reasonable to expect supersonic airliners within the next five or 10 years. "But this does not imply that BOAC would necessarily buy them," he added.

Problems the group will study include range, payloads, operation, air traffic control, maintenance and ground handling, and whether BOAC could remain competitive without supersonic airliners if competitors introduced them.

In another move, BOAC will resume its services between Britain and Israel on Nov. 1, after a four-year lapse. The airline will operate its Britannia aircraft on a twice-weekly schedule between London and Tel Aviv, with a stop at Geneva.

BOAC's Tel Aviv route was discontinued in 1955 when the airline had to rearrange its schedules after withdrawal of Comet's from service.

SHORTLINES

▶ **American Airlines** is now offering a total of 108 turboprop and turbojet flights on 26 different routes. Lockheed Electras operate on 16 routes, serving 11 cities with 70 flights daily; Boeing 707s operate 38 daily flights linking eight cities on 10 routes.

▶ **Chicago Helicopter Airways** carried 20,519 passengers in July, a 118% increase over the 9,406 passengers carried in the same month of last year.

▶ **Delta Air Lines** carried 4,725,669 lb. of cargo during July, a 37% gain over the same month of last year and 7% above the June, 1959, figures.

▶ **Eastern Air Lines** reports that it flew 401,424 revenue passengers a total of 332,471,000 revenue passenger miles on its Lockheed Electra turboprop transports during the first six months of this year. Load factor for the new aircraft for the six month period has been 57.435%. Other types of Eastern-owned aircraft posted a load factor of 52.55%.

▶ **Flying Tiger Line** says July air freight revenues rose 58.9% over July, 1958, to $1,376,972. The freight carrier's seven month air freight revenues now stand at $8,540,777, 38.9% above that for the same period of last year.

▶ **Irish Air Lines** reports a total revenue of $10,517,777 for the fiscal year ending Mar. 31, a 24% increase over that recorded for the preceding year. Net operating surplus realized by the transatlantic and European carrier was $335,084 as compared with an operating deficit of $122,287 for the previous year. IAL carried 500,574 passengers over its European routes and 14,781 passengers on its transatlantic routes during the fiscal year period.

▶ **Pan American World Airways** will extend turbojet service to Frankfurt, Dusseldorf, Amsterdam, Brussels, Hamburg and Copenhagen this winter in addition to serving London, Paris and Rome. The carrier's winter schedules call for 24 round trip flights each week.

▶ **Trans World Airlines** is scheduled to begin Boeing 707 turbojet service between Miami, St. Louis and Los Angeles Sept. 27 on a one-flight-per-day basis.

▶ **United Air Lines** operated 504,071,000 revenue passenger miles during July, a 2% increase over the same month of last year. Air freight ton miles rose 17% to 1,004,000. U.S. mail, including first class, stood at 2,764,000 ton-miles, up 11%.

AIRLINE OBSERVER

▶ Watch for a shakeup in State Department's Office of Transportation and Communications, the section which negotiates air transport bilateral pacts. White House is unhappy over office's recommendations that British Overseas Airways Corp. be granted a Tokyo stop on the carrier's around-the-world route (AW Aug. 17, p. 41). Federal Aviation Agency Administrator E. R. Quesada, who ranks high at the White House, opposed the Tokyo stop but the Administration felt obligated to go along with the State Department's public stand on the issue. This dilemma was one of the chief reasons for the prolonged delay in reaching a final decision in the case.

▶ **Type certification for the Douglas DC-8 turbojet transport was scheduled to be issued last week. Certification now permits both Delta Air Lines and United Air Lines to begin scheduled service as planned on Sept. 18. Type certificate for the aircraft, which is powered by Pratt & Whitney JT3 engines, is scheduled to be presented to Douglas Aircraft Co. today.**

▶ British Overseas Airways Corp., which is now offering only de luxe and first-class service on its New York-London de Havilland Comet 4 turbojet flights, will add economy class service to some Comet flights soon.

▶ **Airline stocks continue to drift downward despite an increase in net earnings reported by the trunkline industry for the first six months of 1959 as compared with the same period of last year (AW Aug. 24, p. 41). Actually, the total $29.5 million net profit reported by the 12 trunklines falls short of the net earnings reported during the first half of 1959 by two single railroads: Union Pacific—$30.2 million and Atchison, Topeka and Sante Fe—$30.6 million. Most stock issues listed on the New York Stock Exchange are experiencing heavy trade activity and are drawing close to 1959 lows. National Air Lines, during the past two weeks, has hit new lows on two occasions.**

▶ United Air Lines President W. A. Patterson is denying reports that United has any merger negotiations pending with another company. He adds: "I am certain, however, that, by 1960 or early 1961, economic conditions in the industry will make it necessary for serious consideration to be given by all concerned to certain logical mergers which would benefit the public."

▶ **Braniff Airways will introduce a one-step reservations and ticketing procedure on a system-wide basis within the next 30 days in line with new programs being adopted generally throughout the industry (AW Aug. 24, p. 38). Plan will permit passengers to book space without picking up tickets at a local ticket office and eliminate delays in buying tickets at airports immediately prior to flight time.**

▶ Resignation of George L. Giles as president of Riddle Airlines will not affect the cargo carrier's plans regarding the Armstrong Whitworth 650 Argosy aircraft, according to Edward T. Thompson, Jr., senior vice president and acting head of the airline. Giles, who took over presidency of the line from John Paul Riddle in February, 1958, cited disagreement over policy as his reason for resigning. Thompson, however, said no major changes in policy are contemplated. Riddle Airlines hopes to receive an Argosy late this year for evaluation before deciding whether to make firm its intent to buy four of the British cargo aircraft (AW Aug. 17, p. 47).

▶ **Lufthansa West German Airlines is expected to show a sizable deficit in 1959 despite a 20% increase in passenger traffic during the first six months of the year. Because of a substantial increase in available ton miles, load factor has fallen from 50.3% last year to 49.3 for the 1959 six-month period.**

▶ Recently established Air Union, made up of Air France, Alitalia, Lufthansa and Sabena (AW Aug. 24, p. 45), is scheduled to begin first joint scheduled operations next April 1.

▶ **North Atlantic passenger traffic on scheduled airlines increased 12% during the second quarter of the year over the number carried in the same period of last year. Number of passengers traveling economy class during the period increased by 39%.**

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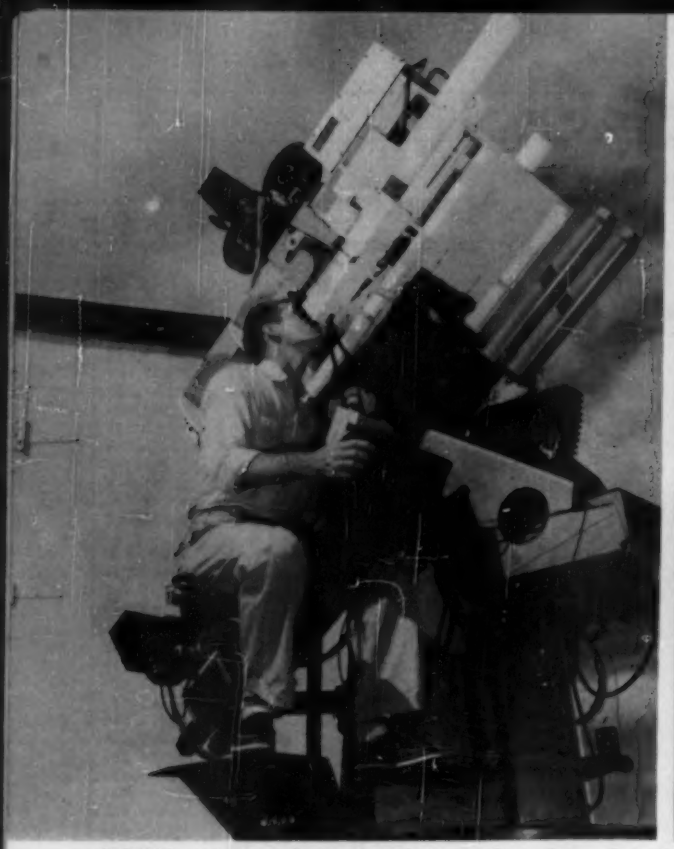
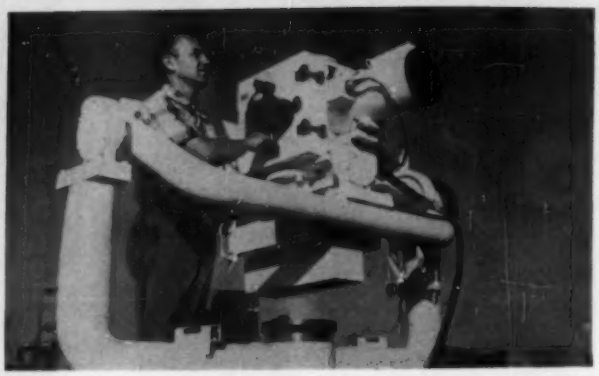
Airline Income & Expenses—2nd Quarter

(IN DOLLARS)

	Passenger Revenue	U. S. Mail	Property	Charter	Federal Subsidy	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	86,419,294	1,813,798	7,290,767	42,970	.....	95,857,974	85,278,112	15,360,749
Braniff	14,889,607	397,198	896,885	69,909	.....	16,349,359	14,760,196	1,553,611
Capitol	26,720,470	561,209	906,929	1,193	.....	28,388,626	27,837,997	312,242
Continental	8,925,861	167,222	322,719	64,597	.....	9,629,483	8,914,539	895,999
Delta	23,919,681	484,294	1,562,746	31,952	.....	26,146,966	24,230,793	1,819,909
Eastern	65,795,355	1,153,388	2,768,478	115,239	.....	70,173,244	65,932,040	3,364,105
National	14,312,136	273,024	895,859	137,241	.....	15,754,093	15,626,272	162,281
Northeast	7,427,437	105,733	280,742	15,216	.....	7,873,393	8,934,834	−1,312,346
Northwest	19,538,171	551,388	1,574,506	19,545	.....	21,787,103	20,180,865	1,409,175
Trans World	63,052,628	1,263,104	3,130,840	274,864	.....	68,036,441	58,845,407	8,600,168
United	73,662,039	2,741,132	6,231,127	616,569	.....	84,155,189	73,268,097	10,779,479
Western	12,408,952	275,522	547,396	47,070	.....	13,347,106	11,065,647	2,092,023
INTERNATIONAL								
American	1,301,197	10,555	184,698	.....	.....	1,573,181	1,694,996	−124,784
Braniff	1,658,120	36,408	217,057	.....	.....	1,977,718	2,016,536	−61,381
Caribbean Atlantic	662,901	7,733	28,302	9,906	.....	676,995	585,650	90,835
Delta	1,288,644	13,743	90,425	.....	.....	1,398,132	1,425,404	−26,266
Eastern	6,112,714	74,774	241,596	97,680	.....	6,534,612	5,890,135	557,943
Mackey	460,860	.....	8,428	744	.....	477,334	437,273	40,239
National	901,596	9,960	63,914	.....	.....	978,239	938,328	41,377
Northwest	6,862,518	1,786,420	1,342,530	14,500	.....	10,347,785	8,233,146	1,986,031
Pan American Combined	70,083,744	4,711,692	10,173,463	3,365,599	.....	90,458,962	84,349,756	6,211,149
Alaska	823,142	43,086	130,443	1,646	.....	1,049,271	1,283,065	−233,506
Atlantic	36,003,847	2,304,003	3,631,473	823,499	.....	43,518,951	37,014,148	6,974,563
Latin America	17,746,090	584,395	3,687,415	402,513	.....	23,005,507	25,032,799	−2,004,419
Pacific	15,510,665	1,781,580	2,724,132	2,137,941	.....	22,885,233	20,990,231	1,986,026
Panagra	3,251,337	129,867	664,037	76,791	.....	4,413,403	4,848,574	−426,859
Resort	.....	.....	.....	1,943,329	.....	1,945,077	1,713,189	234,451
Trans Caribbean	803,317	.....	86,569	51,151	.....	1,075,108	1,138,126	−8,726
Trans World	14,071,444	1,281,599	1,116,407	3,310,885	.....	20,612,299	21,251,951	−471,044
UMCA	11,633	.....	1,656	.....	.....	13,323	35,593	−22,270
United	4,168,318	148,713	91,658	13,200	.....	4,456,010	3,363,360	1,063,801
Western	876,617	13,923	26,673	.....	.....	929,925	995,980	−85,524
LOCAL SERVICE								
Allegheny	1,779,634	32,659	92,379	10,414	700,401	2,623,121	2,672,968	−68,500
Bonanza	954,401	8,830	29,904	12,412	432,522	1,448,376	1,619,788	−209,658
Central	588,981	23,135	36,067	2,435	684,805	1,343,830	1,357,339	−15,366
Frontier	1,258,993	34,000	117,972	21,946	675,090	2,130,395	2,655,797	−570,062
Lake Central	683,569	15,105	21,639	17,586	444,013	1,182,990	1,075,104	89,851
Mohawk	2,169,334	26,416	62,085	36,457	490,813	2,794,542	2,637,321	96,475
North Central	3,030,094	75,075	90,146	68,480	1,108,723	4,389,997	4,501,889	−159,413
Ozark	1,940,579	30,061	88,277	1,684	690,401	2,757,854	2,624,410	124,543
Pacific	1,467,950	37,051	31,850	172,060	738,645	2,452,596	2,076,923	339,450
Piedmont	1,982,385	30,948	63,085	41,949	612,914	2,750,374	2,964,935	−248,929
Southern	852,704	26,859	45,520	13,234	583,829	1,530,007	1,431,646	92,731
Trans-Texas	1,047,043	30,678	64,824	48,235	735,027	1,937,134	1,808,990	117,946
West Coast	1,013,797	14,441	27,468	16,574	898,130	1,979,049	1,964,471	−55,895
HAWAIIAN LINES								
Aloha	754,262	4,758	23,539	754	.....	804,044	779,739	15,003
Hawaiian	1,446,309	10,760	189,276	227,296	.....	1,876,517	2,001,225	−177,771
CARGO LINES								
AAXICO	.....	5,803	131,047	1,388,115	.....	1,316,645	1,104,932	268,437
Aerovias Sud Americana*	.....	.....	.....	.....	.....	.....	.....	.....
Flying Tiger*	.....	.....	.....	.....	.....	.....	.....	.....
Riddle*	.....	.....	.....	.....	.....	.....	.....	.....
Seaboard & Western*	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	1,791,395	.....	1,900,739	1,677,907	155,338
HELICOPTER LINES								
Chicago Helicopter	299,877	10,291	1,580	5,960	435,167	753,645	570,741	172,654
Los Angeles Airways	66,273	38,109	25,588	2,275	227,156	360,240	344,786	15,497
New York Airways	235,875	14,807	15,673	15,902	582,577	889,417	837,539	40,711
ALASKA LINES								
Alaska Airlines	737,569	160,929	146,777	647,846	432,235	2,144,920	2,099,891	29,651
Alaska Coastal	280,102	28,413	30,350	16,565	272,723	638,420	532,758	98,561
Cordova	36,642	29,318	23,738	107,436	99,387	299,451	291,280	−1,337
Ellis	178,626	14,505	22,760	14,901	97,785	331,320	291,463	37,721
Northern Consolidated*	.....	.....	.....	.....	.....	.....	.....	.....
Pacific Northern	2,031,044	202,730	300,519	2,330	467,787	3,038,220	2,734,457	281,534
Reeve Aleutian*	.....	.....	.....	.....	.....	.....	.....	.....
Wien Alaska	275,384	155,933	99,847	505,377	229,034	1,295,674	1,303,240	−4,602

*Not available. **Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.**





OPTICAL equipment plays major role in missile tracking. Left, Sandia tracking camera at Cape Canaveral. Top right, infrared devices mounted on ocean range vessel. Bottom right, camera on wheels can be moved from pad to pad on Cape.

Atlantic Missile Range—Part II

Canaveral Complex Will Remain Top U.S.

By Evert Clark

Cape Canaveral, Fla.—Air Force Missile Test Center's position as the principal U. S. base for space exploration should be assured for the foreseeable future under expansion plans now under way.

At present, the planning allows for as many as 11 more launching pads accommodating rocket engines with thrusts ranging from two million to as high as 10 million lb.

If there is an upper limit on the size and type of space vehicle that can be launched from the half-billion-dollar missile complex, it has not yet been acknowledged by the men whose job it is to forecast such things.

Cape's Limitations

Such apparent limitations as blast effect and the nuisance of noise have caused skeptics to predict the end of Cape Canaveral's usefulness since the first missile was fired here nine years ago.

But each new propulsion advance has been taken in stride, and the planners now expect that what is formally known as the Cape Canaveral Missile Test Annex can be called upon to handle boosters producing 20 times the thrust of the German V-2 that lifted an Army WAC Corporal to an altitude record of 250 mi. in 1950 and introduced missile flight to this area.

In recent years, technology has forced the center to expand even more rapidly than its planners had anticipated, just as it has forced the growth of the rest of the parent Air Research and Development Command and all other segments of the weapons field.

Some of this unexpected expansion has resulted from technological advances that could not be forecast; a great deal of it has been forced by the weapons progress of Soviet Russia.

Particularly in the space field, which already has begun to dominate the center's future planning, Russian efforts have added considerably to the original mission of missile testing.

Currently anticipated needs at Canaveral, for example, have required that two wholly new launching areas be set aside on the Cape, designated as the Very Heavy vehicle area and the Ultra Heavy vehicle area.

Almost two years ago, the center began acquiring some 2,000 acres on the narrowest part of the Cape just beyond what was then the northern boundary of the 13,000-acre launching area.

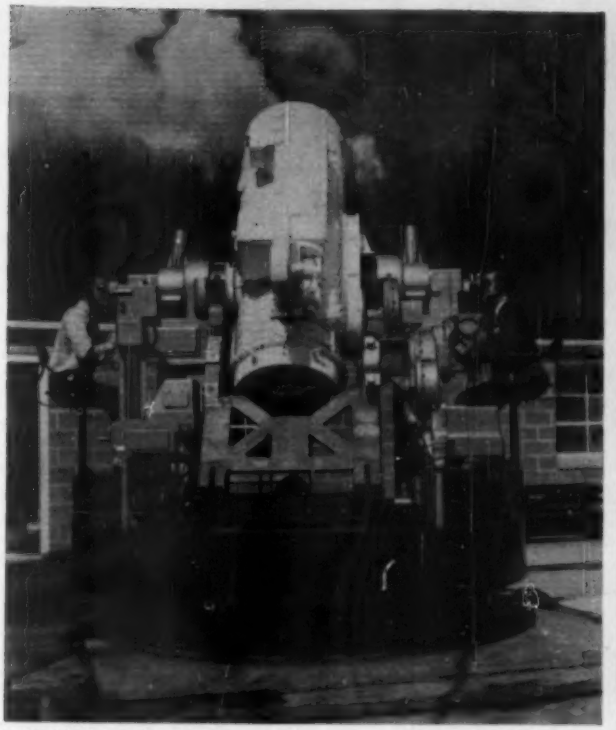
About 90% of this is now owned by the government, and proceedings to obtain the remainder are under way. Even though this neck of land is extremely narrow as compared with the body of the Cape itself, this is the new Very Heavy area.

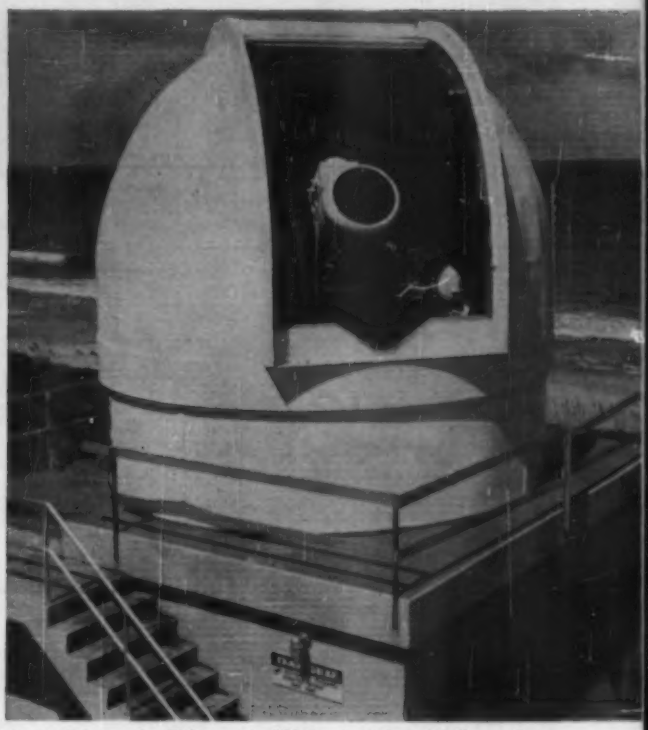
Pad Stacking

Using existing safety standards and the practice of "stacking" pads one behind the other, the area will accommodate six or seven pads with thrust capacities of one to 2½-million lb. It is not known what specific space systems will be assigned there, but the area could handle launching vehicles for the advanced global-range versions of the Dyna-Soar patrol bomber and the very large reconnaissance, communication, navigation, meteorological and astronomical satellites proposed.

The Ultra Heavy area will occupy the seaward tip of the Cape, part of which has been unused and part of which has served as a launching area for aerodynamic missiles.

This area will accommodate at least





TWO VIEWS of Perkin-Elmer ROTI telescope-cameras 30 mi. south of Cape Canaveral. Telescope's 500-in. focal length allows close-ups of missiles in early flight stages. Stage separations, satellite flights have been recorded with these.

Space Base

four large pads that could take engine thrusts ranging from about 3.75-million to 10-million lb. These would be large enough for launchings of multi-manned satellites, support vehicles for permanent orbiting stations assembled in space and man-carrying or support vehicles for lunar and planetary bases. At least one of these pads probably will be used for the six-million-lb. thrust NASA Nova vehicle which still is several years away.

It is not known how many of these new pads are tied directly to expected requirements, but long-range planning for launching facilities generally has been aimed at specific systems whenever possible.

Space Vehicles

While these launching areas remain in a planning category, space flight already is strongly affecting current construction and operation both at the Cape and along the downrange islands:

• **Saturn.** Just south of the former northern boundary of the Cape, two pads and a blockhouse are being built for the ARPA-Army Ballistic Missile Agency's 580-ton, 200-ft.-high Saturn. Eight clustered Rocketdyne 150,000 lb. engines will power its 22-ft. diameter first stage. A modified USAF-Titan first stage powered by two 150,000-lb. thrust Aerojet engines will form the second stage. A Convair Centaur, powered by two 15,000-lb. thrust Pratt & Whitney XLR 115s, will form the third stage. The Centaur will require facilities for handling its liquid hydrogen fuel. This vehicle, with the capability of putting some 30,000 lb. into an earth orbit or sending as much as 1,900 lb. to the vicinity of the planet Jupiter, will be used for a variety of NASA and ARPA space missions.

• **Titan.** Just south of the Saturn complex are four Titan pads. While no space missions have been announced for a complete Titan, its weight carrying capacity exceeds even that of USAF's other liquid fueled intercontinental missile, the Convair Atlas. At least two of Titan's four pads could accommodate boosters for early versions of the Dyna-Soar, which are expected to have some 5,000 mi. range.

• **Atlas.** South of the Titan complex are four Atlas pads. One Atlas already has been put into orbit in Project Score. It also will be used in test shots and to orbit manned capsules for Proj-

Range Maintenance and Operation Contract

Air Force Missile Test Center

(Pan American World Airways Estimated Costs and Fixed Fee as Negotiated)*

Fiscal Year	Estimated Cost as Per Contract	Fixed Fee	Total Face Value of Contract
1954	$4,839,953	$215,000	$5,054,953
1955	11,727,507	440,000	12,167,507
1956	18,125,521	500,000	18,625,521
1957	43,160,029	1,030,000	44,190,029
1958	53,580,000	1,215,000	54,795,000
1959	70,617,620	1,400,000	71,017,620

* Includes Radio Corp. of America subcontract for technical services.

AFMTC Contractor Personnel

Major Missile Contractors

Company	Patrick AFB	Cape	Downrange Stations	Total
AC Sparkplug Div.	.....	39	.....	39
Aerojet-General Corp.	7	67	.....	74
Avco Mfg. Corp.	6	48	.....	54
Bell Telephone Labs.	.....	86	.....	86
Boeing Airplane Co.	222	239	.....	461
Diamond Ord. Fuze	.....	10	.....	10
Int. Tel. & Tel.	.....	1	.....	1
Westinghouse Electric	42	7	.....	49
Convair-Astronautics	34	1,036	.....	1,070
Burroughs Corp.	13	48	6	67
Chrysler Corp.	2	8	.....	10
Douglas Aircraft Corp.	.....	662	.....	662
Fairchild Eng. & Aircraft	.....	3	.....	3
General Electric Co.	18	323	40	381
Interstate Electronics	.....	1	.....	1
Jet Propulsion Laboratory	.....	14	.....	14
Lockheed Aircraft Corp.	2	386	.....	388
Martin Co.	36	762	.....	798
McDonnell Aircraft Corp.	.....	1	.....	1
North American Aviation	.....	29	.....	29
Northrop Aircraft, Inc.	.....	272	8	280
Philco Corp.	1	.....	.....	1
Picatinny Arsenal	.....	11	.....	11
Remington Rand-Univac	.....	9	.....	9
Rocketdyne Div.	8	28	.....	36
Sandia Corp.	.....	6	.....	6
ARMA	.....	39	.....	39
Space Technology Labs.	96	66	.....	162
Totals	487	4,201	52	4,742
Range Contractors				
Pan American World Airways	1,404	2,253	1,201	4,858
Radio Corp. of America	1,793	683	636	3,112
Totals	3,197	2,936	1,837	7,970
All Contractors				
Combined Totals by Location	3,684	7,137	1,891	12,712

ect Mercury; to launch a moon-orbiting satellite; to launch some vehicles in the Sentry military satellite series, and to boost the Centaur and Vega space vehicles. Two of the four service towers have been increased in height, one to handle Sentry and one for Mercury. A fifth pad, using Atlas facilities but with a Titan-type blockhouse, will be added just south of existing pads to launch Vega and Centaur. Vega can put two or more men into an earth orbit and is expected to be used in follow-on Mercury phases. Centaur can boost early versions of Dyna-Soar. Vega uses an improved General Electric Vanguard engine and both it and Centaur could add the 6,000-lb. thrust storable engine now under development by Jet Propulsion Laboratory.

• **Minuteman.** No space missions have been announced for this solid-propellant intercontinental missile, which still is under development, but it is expected to couple the advantages of solid fuel simplicity, high load-carrying capacity and great accuracy that would make it useful as a space vehicle. A launching complex is under construction now next to the USAF-Douglas Thor and Vanguard pads. It is expected to have four launching pads and possibly an underground silo from which to simulate launches from a hardened base.

• **Vanguard.** This vehicle, the only one designed specifically for space launchings, put the small Vanguard I satellite into an orbit that is expected to last 2,000 years. Its solar-powered radio is still transmitting. It also launched Vanguard II, a cloud-cover monitor, but wobbling of the payload so far has prevented the data from being useful. Only one more Vanguard vehicle is scheduled. Plans for the Vanguard pad and tower, which share a blockhouse with a Thor pad, are uncertain.

• **Thor.** This missile with upper stages added to make the Thor Able vehicle was used in three attempts to put a satellite into orbit around the moon. One shot was partially successful, traveling 71,000 mi. into space and achieving a number of secondary scientific goals. Thor, like Atlas, also has produced considerable amounts of scientific space information by launching non-interference experiments on ballistic trajectories aboard General Electric Mark II nose cones. At least one future Thor Able shot will attempt to pass near Venus on the way to an orbit about the sun.

• **Redstone.** This reliable ABMA-Chrysler booster formed the basic powerplant for the Jupiter-C vehicle which put the small but scientifically important Explorers I, III and IV into orbit. It also will be used by Project Mercury space pilots for suborbital flights.

• **Jupiter.** This Army-Chrysler intermediate range missile has formed the basic vehicle for the satellites Pioneer III, which traveled 63,000 mi. into space on an attempted lunar pass, and Pioneer IV, which is now in orbit around the sun. It also will be used by NASA to launch more earth satellites and possibly space probes.

• **Pershing.** This new selective-range ballistic missile is the Army's entry in the solid propellant field, now represented by USAF's Minuteman and Navy's Polaris. No space missions have been announced, but with a 500-750 mi. range, it also should have appreciable space-launching capability. Two pads and a blockhouse are now under construction.

• **Polaris.** This fleet ballistic missile is in early full-scale firing tests. A number of proposals for its use as a space launcher have been made but no approved uses have been announced.

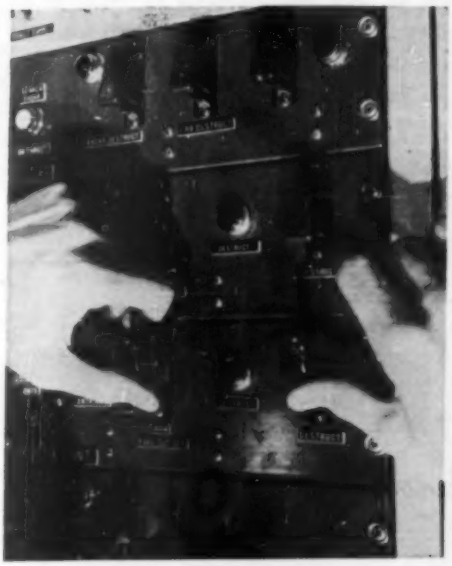
Port Canaveral

Port Canaveral at the south end of the Cape is the only deep-water port in a 400-mi. stretch from Jacksonville to West Palm Beach. Now used by Army, Navy and USAF and commercial ships, it may be the delivery site for Army's Saturn booster, which will be shipped via the Tennessee River, Mississippi River and inland waterway from its assembly site in Huntsville, Ala., probably by an LSD floating dry dock.

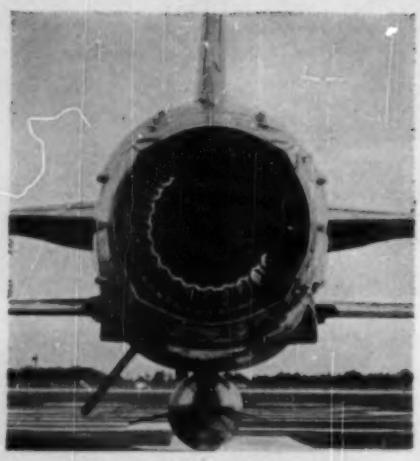
A 75-ton per day liquid oxygen plant will be built next to the existing Air Products, Inc., plant under the Fiscal 1960 program. Liquid hydrogen, scheduled for use next year in the first Centaur firings and for far wider use in later space vehicles here, is produced in a USAF-Air Products plant in the Everglades near West Palm Beach, Fla. It will be trucked here in vacuum-jacketed flasks.

Space projects also affect the planning for the center's eleven downrange

ALTHOUGH missiles and launch pads command most attention, most important work at Air Force Missile Test Center often goes on indoors. Top left, Martin Co. engineer uses blockhouse periscope during live Titan countdown. Top right, recently modernized operations room in Central Control. Right, Convair crew in blockhouse during live countdown on Atlas missile. Bottom left shows complex destruct portion of range safety officer's panel in Central Control. Destruct packages are carried in each stage of multi-stage missiles. Bottom right shows range safety officer's console, electronic flight piloting boards which register position and velocity information collected by electronic sky screens, doppler systems, radar tracking antenna, visual and optical sighting devices.



Republic High-Performance Titanium for the F-105



NEWEST ADDITION TO TAC— the F-105 fighter bomber —is made by the Republic Aviation Corporation, Farmingdale, Long Island, N.Y. Unique clover-leaf speed brake brings the Thunderchief from Mach 2 to subsonic speeds quickly and with no appreciable loss of stability. Alloy grades of Republic Titanium used must withstand 700-degree temperatures and pressures up to 90,000 psi.

In Republic Aviation's F-105—the world's fastest fighter-bomber—mission requirements dictated a high-performance speed brake capable of bringing the plane from Mach 2 to subsonic speeds quickly and with no appreciable loss of stability.

Working closely with design engineers, Republic Steel supplied the titanium for the 360-degree clover-leaf speed brake. Hot formed, the titanium "petals" are designed to withstand searing 700-degree temperatures and the 90,000 psi impact accompanying brake extension at Mach 2.

Look to Republic Steel for new developments in metals to increase strength, resist heat, trim weight. Constantly expanding research, production, and service facilities have made Republic Steel the nation's largest producer of *high-performance* metals—titanium, stainless, and alloy steels.

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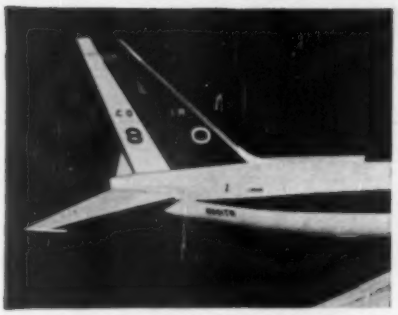
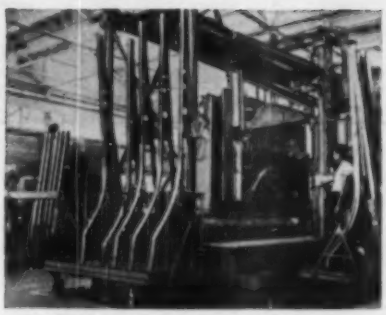


REPUBLIC STAINLESS STEEL is used in leading edges of the Convair 880's vertical fin and horizontal stabilizer where anti-icing is accomplished through electrical heating of the metal. Use of Republic ENDURO® Stainless Steel increases strength and heat resistance, permits thinner, lighter gages. Types 301 and 302 are readily formed into desired shapes by cold-forming, drawing, and bending operations.



REPUBLIC ALLOY STEEL—Type AMS 6428—is currently being used by Rohr Aircraft Corporation in the manufacture of flap track weldments for a major Air Force bomber program. This fine steel provides a minimum tensile strength of 180,000 psi in the heat-treated condition. Also used at 220,000 psi minimum tensile strength for other applications. Return the coupon for information.

REPUBLIC'S NEW HIGH-STRENGTH POWDER, TYPE HS6460,

is ideal for sinterings of highly stressed components. Provides minimum tensile strength of 60,000 psi at 6.4 density as sintered . . . 100,000 psi after heat treatment. Maximum of .004% shrinkage from die size at 6.4 density. Available in quantities up to and including 12 tons or multiples. Can be used with existing operating equipment. Mail coupon for technical data sheet.

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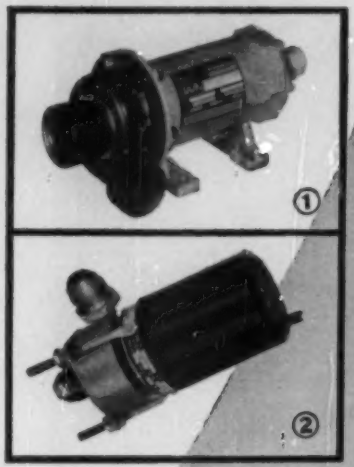

1 Dielectric-Coolant Pump, Model 3631: For liquid cooling systems. Fluid-cooled 5 HP continuous duty motor. Weight, 7.5 lbs. 400 cycles. 115/200 volts. Pump pressure rise: 88 PSI at 53 GPM.

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3 Dielectric-Coolant Pump, Model 3971: For liquid cooling of electronic instrumentation. Fluid-cooled .15 HP continuous duty motor. Carbon bearings. Can run dry. Weight: 21 ozs. 400 cycles. 115/200 volts. Pump pressure rise: 20 PSI at 3½ GPM.

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island tracking stations. Early versions of the Dyna-Soar, which is expected to be essentially an experimental aircraft boosted by rockets, would be launched from the Cape to land on downrange islands at distances up to 5,000 mi.

Downrange Facilities

While the Dyna-Soar program has changed several times in concept and scope, the situation as it existed late in the last fiscal year would have called for downrange facilities at:

- **Grand Bahama Island,** first in the chain, some 150 naut. mi. from the Cape. Facilities that might be needed include a skid strip, runway barrier, landing control station and an aeromedical laboratory facility.
- **Mayaguana Island,** fourth in the chain and some 544 naut. mi. from the Cape. Facilities might include a radar station, landing control station, runway barrier and aeromedical lab.
- **Mayaguez, Puerto Rico,** seventh in the chain and 944 naut. mi. from the Cape, might require a test range facility at Ramey AFB.
- **St. Lucia,** ninth in the chain, 1,400 naut. mi. from the Cape. This might require a runway extension and runway arresting gear, an additional radar installation, an aeromedical facility and control and guidance facilities.
- **Ascension Island,** last in the chain, 4,400 naut. mi. from the Cape. This might require guidance facilities, a landing control station, runway extension and arresting gear and another aeromedical laboratory.

These facility needs indicate that the Dyna-Soar, which would lead to the most advanced of manned aircraft-spacecraft, will begin its testing with short flights and progress downrange in careful steps—just as the first pilotless bombers, the Matador and Snark, did when they became the first missiles to be tested extensively by the center.

Accelerated Buildup

Before the first Russian success with Sputnik I on Oct. 4, 1957, only three vehicles had been launched here with space flight as their primary objectives, and these were simply test vehicles for the Navy-Martin Vanguard with no satellites aboard.

Since then, 22 attempts to launch space vehicles had been made by the first of August and others were scheduled at the rate of more than one a month. Among them were an attempt to put a payload into orbit around the moon and an attempt to reach the vicinity of Venus.

To appreciate the impact of space on the operation of the range, it is necessary first to look at the current workload of missiles, whose boosters

CAPE now has 19 missile assembly and test buildings, 17 of them in industrial area; 13 more can be added on fill land.

DOWNRANGE TRACKING stations are commanded by an officer, manned by missile and range contractor technicians. Equipment is modified as range clearance, safety, tracking and telemetry missions require. Above, left, is Eleuthera Island, second in chain, first used late in 1955 for a Northrop Snark flight. Eleuthera will have a complement of about 183 men in Fiscal 1960. Above, right, is Fernando de Noronha, next to last island in the chain. It is used by agreement with Brazilian government. Volcanic hills rise from 500 to 700 ft. with one peak 1,053 ft. high. Complement is about the same as on Eleuthera. Right, TLM-18 automatic radar tracking antenna sits on lip of precipitous Devil's Pit on Ascension Island, last in the chain. Missiles of intercontinental range impact near Ascension, can be fired beyond its 4,400 naut. mi. distance from Cape and tracked both from island and by ocean range vessels. New data transmission and frequency control and analysis equipment will aid both in missile and space tracking missions.

REPORT FROM ***ARMA***

The Missile Train—Mobile Sunday Punch

In the foreground above is the missile train—a hit-and-run Sunday punch for our modern Army. In event of war, the train could fire a missile with nuclear warhead, move rapidly miles away, then fire other missiles . . . without becoming a vulnerable stationary target itself. The missile train would be an ever-present threat to the enemy's tactical units over a wide area.

For such imaginative projects as the missile train, which combines maximum mobility with maximum firepower, ARMA has developed an equally imaginative universal navigation system. Not only can ARMA systems rapidly locate and aim all types of Army missiles, but they are applicable to all types of land, sea and air operations. To the Army, ARMA offers precise vehicular navigation systems for use in artillery and missile survey, combat vehicles, tanks, and helicopters as well as remote control types for mine detection and atomic blast survey. Precision navigation systems are ARMA's business from ships to ICBM's and—beyond.

ARMA, Garden City, N. Y., a division of American Bosch Arma Corp....the future is our business.

AMERICAN BOSCH ARMA CORPORATION

62

have made the space launchings possible.

Nine different types of missiles are being fired over the center's Atlantic Missile Range now—six of them ballistic and three aerodynamic—and firings of two more ballistic types will begin soon.

Five types of space-launchers are being fired. Pads are under construction for a sixth, the Saturn.

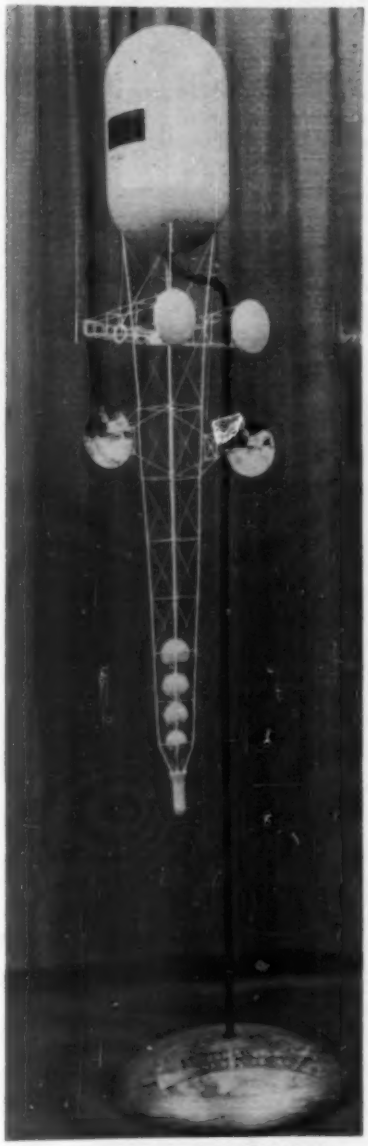
For the future, Air Force is considering at least one more advanced surface-to-surface ballistic missile beyond the Minuteman.

In addition, the range must conduct nose cone recovery operations, track satellites and support occasional air-launchings of aerodynamic and ballistic air-to-surface missiles.

To carry out an operation of this size and complexity with economy and efficiency, the center's commander, Maj. Gen. Donald N. Yates, and the range operators—Pan American World Airways for operation and maintenance and Radio Corp. of America for technical services—must know as far in advance as possible what future range requirements will be.

Although no official manual of operation says so, this essentially requires three kinds of information gathering—formal, informal and intelligence. There must be coordination with various levels of the Air Force, Navy and Army, who have used the range for some time, and now with the two space agencies—National Aeronautics and Space Administration and Defense Department's Advanced Research Projects Agency.

Sometimes by instruction but often simply by deduction, the planners must know what will be needed early enough to go through the long legal processes of obtaining necessary land; to plan



Boeing Space Vehicle

Boeing Airplane Co. has designed a manned space vehicle that would be built in orbit around earth inside a plastic bubble having controlled atmosphere and pressure. Design envisions seven levels and reactor-powered plasma jet engine.

Light...high capacity...

and safe for the "Skin"!

NEW BUCKEYE OVERWING NOZZLE

with 3 rubber-covered protector rings

PROTECTS WING SKIN DURING REFUELING

Buckeye's #12101A overwing nozzle is loaded with features that make refueling safer, easier, more economical, too. 3 bumper rings keep metal parts of the nozzle away from the aircraft skin. Hose wear is held to a minimum by the built-in 360° inlet swivel. The 2-inch N.P.T. swivel turns freely on teflon and ball bearings and is accessible for repair.

The 60 mesh strainer assembly, located in the outlet, is removable by hand. 100 mesh strainer is optional. Replaceable trigger guard comes with a handy loop for hanging. Standard equipment includes dust cap, ground cable and aluminum deflector tube. It's the easiest-to-use, easiest-to-work-with nozzle ever designed.

Balanced Type 2" Aluminum Nozzle is easy opening, soft closing to reduce shock problems. Weighs just 12½ lbs.

For full details on this and other Buckeye Aviation Refueling Equipment, write:

Buckeye BUCKEYE IRON & BRASS WORKS
P.O. Box 883, Dayton 1, Ohio

GROUND SUPPORT EQUIPMENT

A Proven Kearfott Capability – Kearfott's prominence in the design and production of ground support equipment is a result of 15 years' experience in producing precision servo systems, computers, gyro reference systems and inertial guidance equipment. Kearfott test equipment is designed on modular principles which increase flexibility and economy and eliminate the obsolescence factor since modules can be readily modified or replaced. Modules are designed to be compatible with one another, thus providing test capabilities for a wide variety of applications.

Inertial Guidance System Test Console

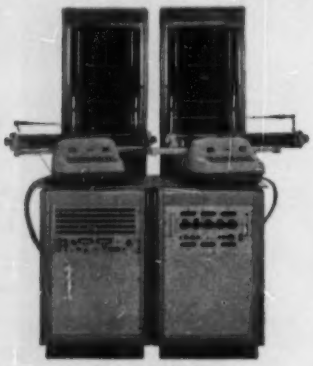
IN-PLANT TEST EQUIPMENT: Rack-mounted modules comprise the necessary metering circuits, signal generators and power supplies, switching circuits and junction boxes to perform the following tests on inertial reference systems:

Voltage and phase • Current • Heating cycle checks • Verticality of platform in ground erection mode • First order erection time in ground erection mode • Measurements of platform roll and pitch output angles in ground erection mode • Measurements of free drift of platform in azimuth in ground erection mode • Measurement of azimuth gyro torquer scale factor in ground erection mode

FIELD-TYPE TEST EQUIPMENT: Modularized, self-contained unit that provides all power and signal voltages to operate, test or trouble-shoot a gyro. All inputs to and outputs from the gyro are accessible at convenient jacks where connections to measuring equipment can be made, thereby enabling operator to evaluate gyro performance completely. Modules are slide-mounted for ready access if repair, modification or product improvement replacement are required. This portable equipment performs these basic tests:

Insulation resistance • Warm-up time • Torquer scale factor measurement Gyro transfer function • Free drift • Gimbal offset drift • Continuity Signal Generator Null • Phasing • Gyro drift • Fixed torque restraint

Floated Gyro Test Console



Scanalog 200-Scan
Alarm Logging System

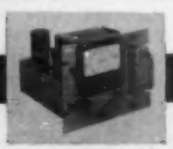
GENERAL PURPOSE DATA PROCESSING: This data handling system provides a reliable, precise means of monitoring, logging and performing an alarm function of up to 200 separate temperature, pressure, liquid level or flow transmitters. Manual controls are provided for scanning rates, automatic or manual logging, data input relating to operator, time, day, run number and type of run. 200 numbered lights, corresponding to specific points being maintained, provide a visual "off normal" display for operator's warning. This system has growth built in and can be expanded in capacity to 1024 points and in scanning rate to 2000 points per second.

Write for complete information on Kearfott's ground support equipment.

Engineers: Kearfott offers challenging opportunities in advanced component and system development.

VTVM-PSVM

High-Speed
Precise Angle
Indicator Module



Automatic
Ohmmeter
Module

Kearfott

A GENERAL PRECISION COMPANY

KEARFOTT COMPANY, INC., LITTLE FALLS, N. J.

A subsidiary of General Precision Equipment Corporation
Sales and Engineering Offices: 1500 Main Ave., Clifton, N. J.
Midwest Office: 23 W. Calendar Ave., La Grange, Ill.
South Central Office: 4211 Denton Drive, Dallas, Texas
West Coast Office: 253 N. Vinedo Avenue, Pasadena, Calif.

water, sewer and extensive electrical lines for new areas so they have sufficient capacity for later requirements; to reserve areas that might otherwise be parceled out bit by bit for less important uses.

In many cases this must be done while missile or space systems are still ideas—before they have become funded programs and sometimes even before they are firmly in the study stage. Consequently, this kind of planning must be done not once or twice a year but continuously.

The result is that no plan remains static for long.

High-Thrust Complex Under Construction

Edwards AFB, Calif.—Part of a high-thrust complex is under construction here at the missile captive test site. Two new stands will be built to be located just east of present test stand 1-A. Initially the stands will be used to test the F-1, 1½-million lb. thrust rocket engine now being developed by Rocketdyne Division of North American Aviation, but the stands are being constructed with a capability of testing engines generating 6 million lb. thrust.

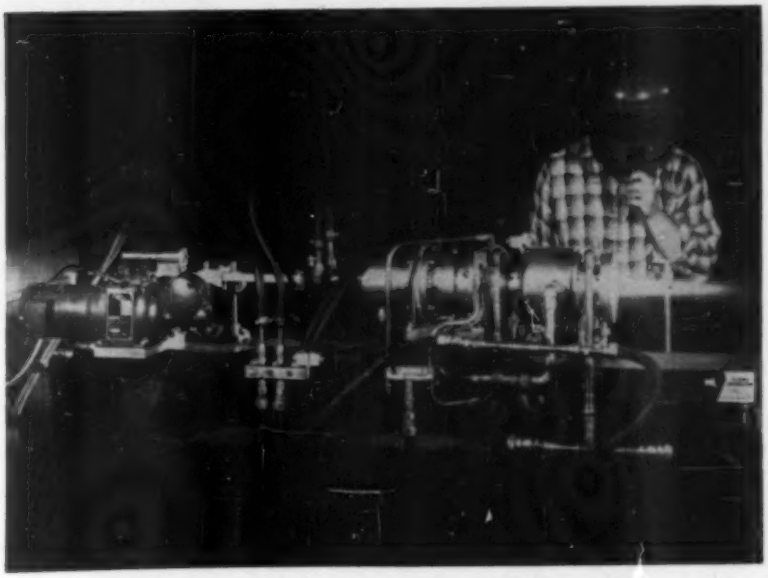
Concrete is now being poured for test stand 2-A, under construction by Rocketdyne, which will be able to withstand 1.5 million lb. thrust, and will hold the engine horizontally. A new gantry is being built on stand 1-A, and this stand will also be used in the F-1 development program.

The 6 million lb. thrust test stand is being constructed by Aerojet-General Corp. and design completion is expected in October. Construction of this stand, to be known as 1-B, will take more than a year. The 6 million lb. package will consist of a cluster of four F-1s and could be used to orbit extremely large satellites or a vehicle for deep space probes.

The large concrete and steel units will tower some 270 ft. and will have a 60 sq. ft. opening for the rocket engine's exhaust. Deflection apron will be cooled by a flow of 75,000 gal. of water a minute during a firing. Rocketdyne will conduct testing on stands 1-B and 2-A under National Aeronautics and Space Administration cognizance.

Astrodyne Gets Contract For Megaboom Production

Solid propellant research and development contracts worth about $2 million have been awarded by USAF to Astrodyne, Inc., McGregor, Tex. Job calls for development and testing of large scale rocket motors and for manufacture of Megaboom solid propellant rocket motors for Holloman AFB.



JPL Using Avco Plasma Generator

First production model plasma generator produced by Avco's Research and Advanced Development Division has been purchased by Jet Propulsion Laboratory. Unit supplies continuous flow of air at temperatures up to 18,000F and with pressures characteristic of hypersonic re-entry of ballistic missiles. Arc uses 20 kw. to more than 1 mw. of power. The generator allows simulation of environmental conditions of air enthalpy, pressure and heat flux associated with re-entry. Avco said the device also has been used for arc-heated wind tunnel experiments. Unit is normally operated with air but may also operate with other gases, including helium, argon and nitrogen.

ONE SURE SOURCE

for design, engineering and manufacturing in all types of metalworking

Interested in precision machined parts? . . . Bliss machines rocket and missile nose cones, domes and cylinders, large diameter thin-walled pieces that must be held to wall thickness tolerances of ±.002".

. . . Or atomic assemblies and components? . . . Reactor core lifting and other core handling equipment, welded pressure vessels and small machined parts are all produced by Bliss.

Projects with more than a touch of the unusual? . . . Most U. S. Navy carriers have Bliss-built catapults . . . Just recently a Bliss overrun barrier saved both pilot and plane when a jet's brakes failed . . . Right now you'll find sections of what will be the world's most powerful radio telescope being assembled on the 600,000-square-foot floor of the Canton plant, one of ten Bliss plants in the U. S. In a word, Bliss has the facilities and skills to take any job involving metal manufacturing from plan to finished product.

Whether you need a complete turn-key plant or quantities of precision machined parts, large or small, you'll be wise to get a bid from Bliss.

E. W. BLISS COMPANY
Canton, Ohio

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SINCE 1857

DEW LINE main station, one of six which serve as data collection, communications and maintenance headquarters for 9 or 10 smaller stations in each of six 500-mi. sectors. Main station has surveillance radar (spherical radome), gap-filler radar (atop high mast), tropospheric scatter systems for lateral voice/teletype communications across the line (parabolic and large billboard antennas above), and ionospheric scatter system to provide rearward teletype communications. Ionospheric scatter antennas are not visible above.

DEW Line Demonstrates Effectiveness

By Philip J. Klass

North of the Arctic Circle—"Nobody, including the Strategic Air Command, has yet been able to sneak an airplane through the DEW Line, and they won't either," according to Squadron Leader Keith Ball, Royal Canadian Air Force officer who commands one of six sectors in the radar picket line which stretches 3,000 mi. across the Arctic.

An AVIATION WEEK visit to six of the nearly 60 DEW (Distant Early Warning) Line stations, and conversations with some of the nearly 1,000 civilians and military personnel who man the line, reveals reasons for such confidence.

Today, less than two years after the DEW Line went into full operation, it is performing its intended mission with an effectiveness and efficiency which would do credit to a military establishment operating in a far less difficult environment.

Exact figures on operational reliability of the DEW Line cannot be disclosed. However, military commanders of several of the sectors told AVIATION WEEK that there had not been a single "hole" in their 500-mi. sector's radar coverage during their own tour of duty—and some of these officers had been on the line for more than seven months.

Duplicate Radars

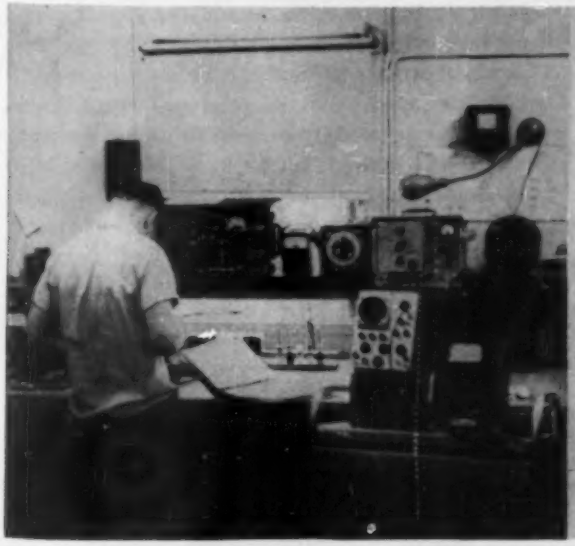
This does not mean that there have not been equipment failures. Rather, it testifies to the soundness of the original DEW Line design. Every radar, and communications equipment, is installed in duplicate to provide backup. Furthermore, the approximately 30 main and auxiliary stations (each with rotating surveillance radar) are located an average of only 100 mi. apart. This overlapping coverage assures that complete loss of one station, even from a catastrophe such as a fire, would not leave a gap in the line which could not be filled by adjoining stations.

The reliability of the DEW Line radar detection would be of little value without equally reliable and dependable communications between individual stations on the line and between the line and the North American Air Defense headquarters in Colorado Springs. Each main station, which serves as a radar data collection center for the nine or 10 stations in its sector, has both a direct teletype and telephone line to Norad headquarters. Pick up the telephone in any one of the six main station data centers and you find yourself talking to the switchboard operator in Colorado Springs.

This direct voice circuit is provided over the same tropospheric scatter system which provides lateral communications between each of the main and auxiliary stations across the entire DEW Line and which connects into rearward tropospheric scatter systems and landlines at both ends of the DEW Line. If the rearward circuits should be inoperative at one end of the line, the message is routed down the other end.

In addition, each of the six main sta-

MORALE of civilians who operate and maintain DEW Line is good. Food is plentiful with an ample supply of fresh vegetables and pastries. Recent movies are shown three times a week (right). Federal Electric Corp. operates the line under USAF contract.



CARE of equipment and personnel is performed right at the DEW Line. Each main and auxiliary station has well-instrumented facilities for checking out avionic equipment (left). Each main station has a doctor or dentist who "doubles in brass" in emergencies. Doctors pay regular calls to the smaller stations.

tions has its own rearward teletype communications to Norad and other key U. S. and Canadian air defense centers using ionospheric scatter communication systems. These rearward teletype circuits, coupled with the lateral tropospheric DEW Line circuits which handle voice as well as teletype, provide a multiplicity of connections to Norad.

To assure that every unidentified target report sent by teletype is received by Norad, the message always is sent by two alternate routes. In addition, test messages are exchanged between each main station data center and Norad at least once every 30 min. to be sure circuits are operational.

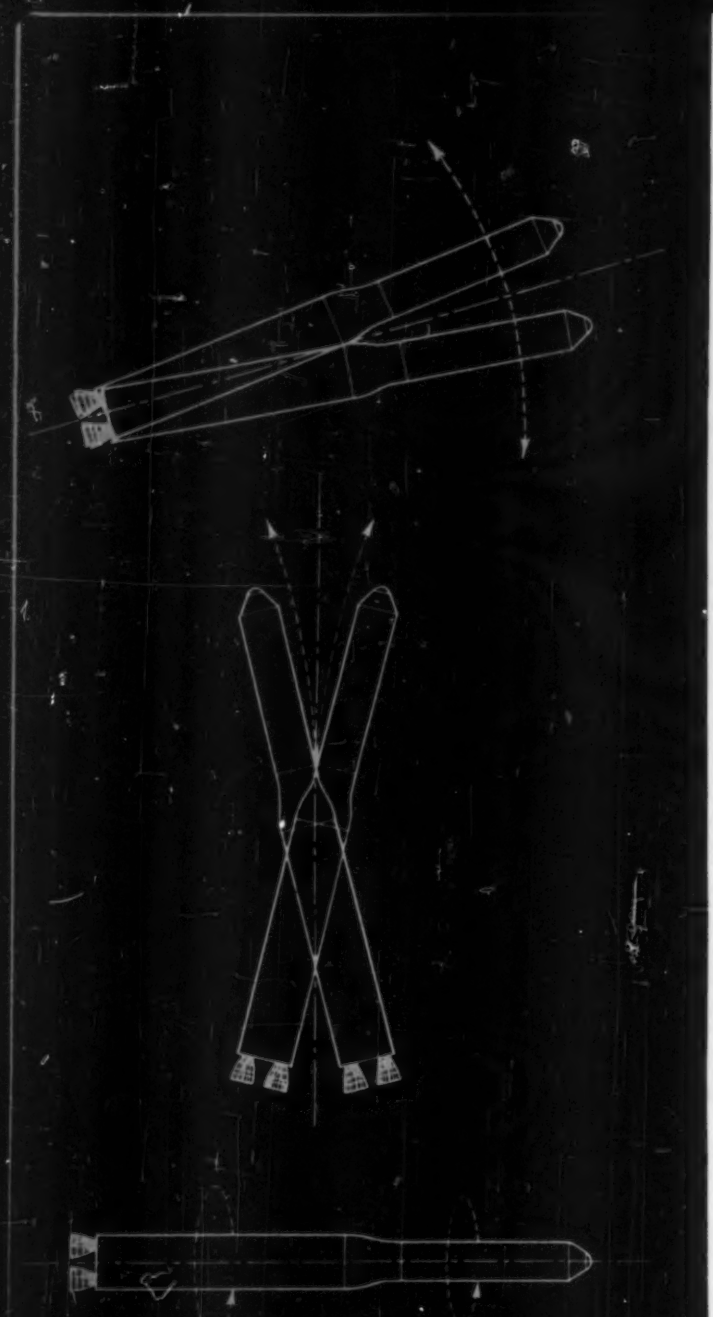
For emergency communications, each main/auxiliary station is outfitted with a high-frequency (HF) transmitter-receiver in the main building, as well as another located in a remote building in the event that the main station is damaged by fire or explosion.

At the time of AVIATION WEEK's

DEW Line Layout

The 3,000-mi. DEW Line consists of approximately 30 search radar installations, located at roughly 100-mi. intervals along the line. Approximately midway between each search radar station is a small gap-filler radar installation. The types of stations are as follows:

- Main station, of which there are six, serves as command, communications, maintenance and supply headquarters for a group of nine or 10 stations which make up each of six DEW Line sectors. Each main station has two search radars manufactured by Raytheon, one providing high altitude coverage, the other providing low-altitude coverage. Station also has receivers and automatic alarms operated by two adjoining gap-filler radars, made by Motorola. Each main station also has at least one ionospheric or tropospheric scatter communications installation to provide rearward radio teletype link to air defense centers in U. S. and Canada. Scatter communications equipment was made by Collins Radio. Main station, commanded by six military personnel and operated by approximately 30 civilians, also houses another 30-40 roving technicians who serve other stations in the sector.
- Auxiliary station, of which there are approximately 25, also is equipped with two search radars and receivers. Auxiliary station is operated by approximately 20 civilians, has no military personnel.
- Intermediate station, of which there are approximately 30, has two gap-filler doppler radar transmitters and antennas, each beamed to the adjoining auxiliary or main station. Station is operated by approximately five civilians.

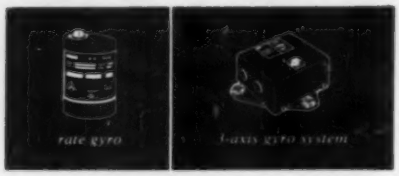


another subsystem from ***Giannini***

Three-Axis Rate Gyro System for Titan

Flight stabilization of the Martin Titan required a package gyro system which provides the highest degree of performance stability, accuracy and reliability under severe environmental conditions. Giannini met and exceeded the requirements by designing a three-axis gyro system for flight control and to telemeter pitch, roll and yaw rates... the result of years of experience in the development of gyro instrumentation.

The system incorporates three standard Giannini rate gyros, a telemetering network and other circuitry in a highly compact package. Two systems are now in use on each Titan. Additional information on the Three-Axis Rate Gyro System is available on request.



Giannini Controls Corporation

918 East Green Street, Pasadena, California

Engineering opportunities now exist at Giannini for work on similar avionic systems. Introduce yourself by writing to the Director of Technical Personnel

visit, intense sunspot activity had completely blanked out the HF radio communications along the DEW Line. Despite this, both lateral and rearward voice and teletype communications were fully operational.

Dial System

Considering that five years ago it might have required months to send a message from a desolate site at one end of what is now the DEW Line to another site at the other end, the automatic dial telephone service now available is little short of remarkable.

Pick up a phone in any office, or at frequently spaced intervals in the hallways of the station, and you can dial directly any phone in any other station along the 3,000-mi. line. If the party being called doesn't answer his phone, the number can be redialed with the digits "69" at the end, which automatically connects the caller into the other station's public address system in order to page the party being sought, i.e., "John Baker, call Col. Rollag, Cambridge Main station, Ext. 35."

All DEW Line vehicles are equipped with two-way radio so that key personnel, even when traveling in the vicinity, can be contacted immediately.

The successful operation of the DEW Line to date supports the wisdom of the original Air Force decision to utilize a civilian contractor to operate and maintain the line, under Air Force supervision.

Some observers speculate that this practice might also find use for domestic intercontinental ballistic missile bases and/or for the SAGE air defense system.

Yearly Contract

Federal Electric Corp., a subsidiary of International Telephone & Telegraph Corp., operates the DEW Line under a yearly contract. The ITT service organization has just been awarded a $42 million contract for the current fiscal year.

The contract is monitored and administered by the Air Defense Command's 4601st Support Group (DEW), commanded by Col. A. J. Reynolds, based at Federal Electric's Paramus, N. J., headquarters.

A total of approximately 950 Federal Electric civilians operate and maintain the nearly 60 DEW Line stations. Of this number, about 140 are native Eskimos. Military personnel are located only at each of the six main stations where they provide military command of each sector and operate the data center into which all information on radar-sighted targets is fed from other stations in the sector. Target data is plotted by military personnel, compared with flight plans on file, and unidentified targets reported to Norad and other key defense centers.

Normal military complement at each station is six officers. The commander has the rank of major or squadron leader (RCAF equivalent). Four other officers, with rank of captain or flight lieutenant, serve as data center controllers. Sixth military representative, a USAF major, is an administrative contracting officer representing the 4601st support group.

Four of the six DEW Line sectors, located in Canada, are directed by RCAF personnel with only the single USAF administrative contracting officer at each main station. Over 90% of the civilians employed in these four sectors are Canadian citizens or from other British Commonwealth countries. Percentage would be even higher if qualified personnel could be found.

Canadian manning of that portion of the line appears to have eased the question of Canadian sovereignty and "foreign bases," raised by a small, but extremely vocal, segment of the Canadian press when the DEW Line was first proposed. (The U. S. foots the bill for operating all of the DEW Line, while Canada pays the cost of operating the Mid-Canada radar line.)

Canadian and U. S. officers with whom AVIATION WEEK talked say that relations between the services of the two countries on the DEW Line "couldn't be better." On-the-spot observations confirm this.

Remoteness of Sites

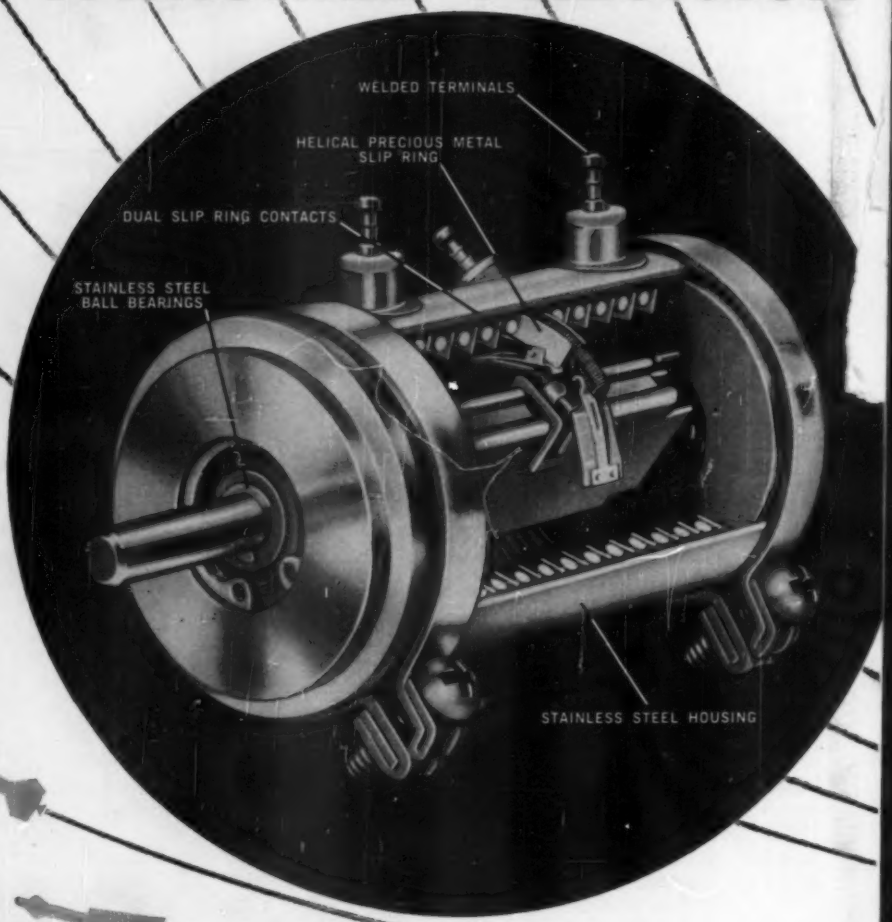
Despite the remoteness of the DEW Line sites, there is not the expected feeling of complete isolation from civilization—at least for a visitor. Part of this stems from the modest comfort of the station accommodations, the good food with plenty of fresh vegetables.

Mail arrives at least twice a week, brought into main station air strips by contract air carriers. From here it is promptly dispatched by a Douglas

SURVEILLANCE radar radome is at left; gap-filler doppler radar is on top of mast. Tropospheric scatter antennas at lower right are for lateral along-the-line communications.

Proven in flight...

FAIRCHILD PRECISION



FAIRCHILD TYPE 909 MULTI-TURN HAS ALL-METAL • STOPS • SLIDER • ROTOR • HOUSING

There are no phenolic, plastic or other non-metallic materials in the type 909's mechanical components. This rugged, precision ⅞" diameter 10-turn potentiometer offers the utmost in reliability and performance.

The design can be built with linear as well as non-linear functions. It has low noise, good shock and vibration characteristics and excellent linearity (± 0.5% to ± .05%). Temperature range is —55°C to +90°C standard and to +150°C in high temp version. Several units can be ganged on a common shaft in from 3 to 20 turn configurations.

POTENTIOMETERS

Having missiles fire as predicted is becoming more and more vital to the defense program. The reflection of this is the increased importance of the Reliability factor, or in a phrase the *"Predictable Excellence"*, of components.

In the future less business will go to the unproven though low priced producer. Management has learned that the lowest initial cost does not always result in the lowest end cost.

Fairchild's precision potentiometers are *proven performers*. They are flying with *predicted excellence* in the nation's most important missiles and aircraft, some of which are illustrated above. They have a reputation for sustained high accuracy, lowest noise level and long life. As a result, Fairchild Reliability is fast becoming an industry standard.

For example, Fairchild High Reliability pots contain only high temp stabilized materials, welded terminations, and precious metal contacts. They are built to close dimensional and design control. And they are subjected to a continuing inspection and quality control program which includes torture testing 1 out of every 100 production units.

For more information write Dept. 26-Y.

3-TURN High Reliability POTENTIOMETERS

This ⅞" dia. type 906 is one of three sizes offered by Fairchild. All feature exclusive long-life wiper guide mechanism.

10-TURN High Reliability POTENTIOMETERS

Available in ⅜" to 1 3/16" dia. and in 3 different designs to suit your needs. The 1" dia. type 920 shown above takes 30 G's at 2000 cps.

SINGLE-TURN LINEAR AND NON-LINEARS

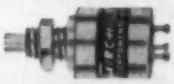
Type 751 ⅞" dia. is one of 28 different types available in sizes up to 5". Functional accuracy over life is guaranteed — Fairchild's "Safety Factor" for reliability.

SINE-COSINE POTENTIOMETERS

Sizes 1⅛" to 5" dia. Built with Fairchild High Reliability resistance elements featuring top-wiped, shaped card windings which provide higher resolution and conformity regardless of position.

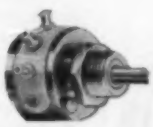
LINEAR MOTION POTENTIOMETERS

The flexibility of the type 910 design permits 1 or 2 resistance elements, and various stroke lengths. MIL-E-5272A environments are exceeded for the Fairchild Reliability "Safety Factor".



MINIATURE TRIMMING POTENTIOMETERS

¾" dia. type 926 and ½" dia. type 927 exceeds MIL Std. 202A, rated 150° C. Metal case and precious metal contacts are Fairchild's reliability "Safety Factor".



SINGLE-TURN METAL FILMPOTS

Precious NOBL-OHM metal film resistance element offers infinite resolution, temperature operation to +225° C and low quadrature voltage.

FILMPOT 28-TURN TRIMMERS

For rugged environments and temperatures when infinite resolution and unsurpassed reliability is required. Available from stock.

RELIABILITY INSIDE THE BLACK BOX

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Get Those Good Ideas "Out" of Storage

'Way up front on the administrative level or deep in the development stage, good ideas have no right to go into storage because of small tubing problems.

We've made it a TMI specialty to think them out of trouble and into successful production fast.

If it takes the most involved testing formula to accomplish our goal . . . we have it in full experienced operation: electronic, ultrasonic, X-ray, pressure, bend, tensile micro-visual and classified! One of them or all of them . . . always at your service at TMI.

Only the Best Quality Cold Drawn Stainless Steel and Special Alloy Tubing Is Worthy of the Name

TMI

Serving a selected list of pioneering customers in aviation, nuclear energy, instrumentation and quality manufacturers in the metalworking industry. If your work is classified it stays that way *all ways* at TMI.

TUBE METHODS INC., Bridgeport, Montgomery County, Pennsylvania. Engineers, Metallurgists and Manufacturers Since 1941.

The Mark of Quality TMI

DC-3 and single-engine aircraft to auxiliary and intermediate (gap-filler) stations.

Men on the line frequently are able to talk with families at home by means of the station's HF (emergency) radio and the services of a radio amateur ("ham") in their home town. Recent-vintage movies are shown three times a week.

One of the most stimulating contacts with the outside world for DEW Line personnel is the regular monthly inspection visit by a group of Federal Electric and Air Force officials. The visiting officials normally spend five to 10 days touring the line, hitting the main stations and some of the smaller ones, get a first-hand look and report on current operating status and problems.

A specially outfitted C-54, named Aurora, flown by Capt. Thomas Garanflo of the 4601st Support Group, provides transportation for the inspection team.

Federal Electric and Air Force officials come armed with latest figures compiled in Paramus headquarters on each station's reported equipment failures, spare parts consumption. For example, during a recent inspection tour, officials made it a point to visit one of the auxiliary stations to find out why its equipment failures were running considerably higher than those of other auxiliary stations on the line.

Keeping Alert

Despite the remoteness of the DEW Line, there is considerable air traffic to keep the radar operators, called radicians, alert. Most of the traffic consists of air carrier operations between stations and between the line and the southern staging areas. Occasionally there are SAC flights with prior approval of the Canadian government.

For example, in one of the Canadian sectors during the month of June a total of 500 aircraft tracks were reported, of which five were initially classified as unknown, and subsequently were identified as friendly.

To maintain console operators constantly on the alert and practiced in reporting targets, radar target simulators are being installed at each of the six main stations. The simulator, produced by Philco Corp., will enable a military data center controller to introduce up to three synthetic targets simultaneously on the radar scopes without advance warning to the radician on duty. Radar will still perform its regular surveillance function, displaying both real and synthetic targets.

At the Barter Island main station (BAR-Main), the simulator was demonstrated for AVIATION WEEK. Without knowledge of the radician on duty, a synthetic target was introduced by the simulator. By the second sweep of the antenna past the synthetic target, the radician had spotted it and reported it to the data center.

RADAR TARGET simulators are being installed at each main station to keep radar operators on their toes.

Maj. Henry D. Nix, commander at BAR-Main, says the synthetic target is so realistic in appearance and movement that even an experienced radician cannot distinguish it from the real thing.

Work Day

Radicians, like other DEW Line personnel, normally work a nine-hour day, six days a week, or a total of 54 hr. (Nine-hour day allows an overlap between different shifts.) At main and auxiliary stations, a team of two radicians normally works each shift. One man spends about 4½ hr. monitoring radar scopes, while the other performs routine maintenance, such as checking equipment performance. During the second half of the shift, the two radicians shift jobs. Several stations currently are experimenting with 2½ hr. cycles of duty to determine whether they are preferable.

Radician at the radar console must monitor two scopes. One displays targets picked up by high-beam surveillance radar; the other by the low-beam radar. In addition, the radician monitors the two gap-filler radar receivers whose output is plotted on two strip recorders.

All radars are equipped with automatic alarm circuitry designed to sound an audible and visual alarm whenever a new target is detected. This automatic alarm occasionally is triggered falsely by ice storm echoes, floating ice masses, temperature inversions or flocks of geese, AVIATION WEEK was told.

When a new target is detected, its location, heading, approximate speed and altitude and related information are set into a device in the console which automatically transmits them to the sector's main station data center where they are printed out on a teletype machine for plotting and analysis by the military data center controller.

If new target information cannot be

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transmitted to the sector data center within a specified time, because of busy or disrupted communication circuits, it is transmitted to an alternate sector main station data center.

If the new target is not identified as a known/friendly aircraft by the military controller, he transmits a report on target to Norad headquarters. The report also goes to Alaska Air Command and to RCAF air defense centers. At present, these rearward messages must be composed manually on a conventional teletype keyboard.

New automatic message composing device, developed by a DEW Line radician, is being fabricated by Philco of Canada and soon will be installed at all main station data centers. The radician, E. W. Blackwell, received a $1,000 award from Federal Electric for his idea and efforts.

Prototype devices, assembled from available spare parts, was first tried at the Pt. Barrow (POW) main station.

Changes Made

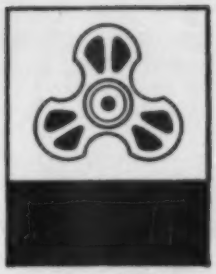
Two years of operation have pointed up the desirability of minor changes in DEW Line procedures and organization, but have not disclosed any basic shortcomings in original design, according to J. S. Willis. Willis, retired Army Signal Corps brigadier general, is assistant DEW Line project manager for Federal Electric. Project manager is Richard H. Cruzen, a retired vice admiral.

Here are a few representative examples of the sort of changes that have been introduced since DEW Line went into operation:

• **Decentralization:** Originally the DEW Line was divided into an eastern and western region, each with three sectors and with a regional supervisor. Now each of the six sectors reports directly to FEC's Paramus headquarters.

• **I-Station staff:** Originally it was thought that the small intermediate stations with only fixed gap-filler radar transmitters could be operated by a two-man team and might eventually be operated unattended. Experience showed, however, that the work involved in keeping the station in operation, access roads and landing strip cleared in winter, required four or five men.

• **Supplies:** In an area where supplies must either be brought in by sea only once every year, or by airlift, it is vitally important that supplies be adequate and balanced to consumption needs. Originally spare parts for electronic equipment was cataloged and stocked according to the part number assigned by each individual equipment manufacturer. This meant that a relay might be stocked under one number for a radar, while the identical relay was stocked under another number for a communications equipment. This not



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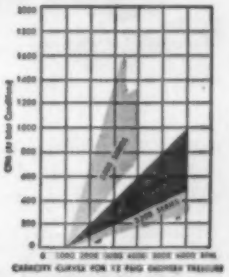

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only complicated storage and bookkeeping, but could result in emergency requests for a spare part which was already in stock under a different manufacturer's part number. The DEW Line now is in the process of changing over to Federal Stock numbers which is expected to slash the number of different stock items listed and carried by nearly 50%.

Willis told AVIATION WEEK: "We have problems, but they are commonplace problems with commonplace solutions."

The men who operate the DEW Line are not the "sourdough" types one might expect to find in the Arctic. For one thing, the men are clean-shaven. Although a beard is not cause for outright dismissal, Adm. Cruzen has let it be known that men who grow beards will not have their contracts renewed.

In terms of atmosphere and appearance, a DEW Line station resembles a Federal Aviation Agency traffic control center more than it does a conventional military base or an Arctic outpost. The men are predominantly in their 20s or early 30s.

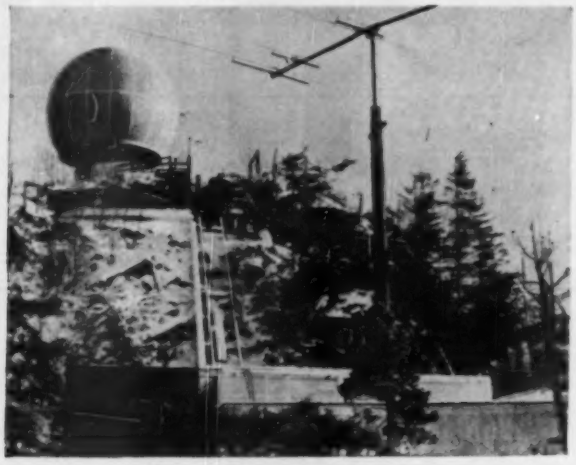
The most important motivation for signing up for an 18-month tour of duty here is the opportunity to build up a financial nest egg. However, many of the men—particularly the radicians who man the radar scopes—express a feeling of dedication to what they strongly feel is an important element of their nation's defense.

Radician's Pay

Except for supervisory personnel, the radician earns top pay on the line. His salary is slightly more than $10,000 per year, with a 10% increase for his second tour of duty. Considering that the men work a 54-hr. week, this is not a great deal more than they might earn in industry. However, with room and board provided, and little opportunity to spend money except for incidentals, a man can bank most of what he earns, unless he has a family at home. More than half of the men are married.

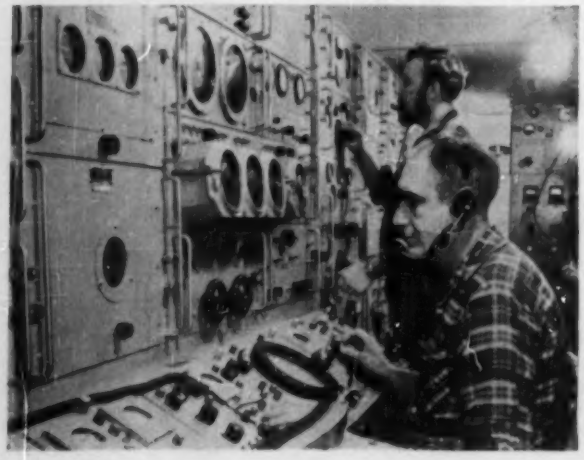
Morale appears to be excellent. Federal Electric reports that two-thirds of the men who have completed a first 18-month tour have signed up for a second 12-month assignment. Although only a few of the men who came on the line before it became fully operational have now completed a second tour, a substantial percentage of these are signing up for a third tour. The men receive a month's vacation between tours, and a two-week leave mid-way in the first 18-month assignment.

Military personnel on the DEW Line are on 12-month assignments, without extra pay. Almost without exception they do not ask for a second tour of duty, although one sector commander told AVIATION WEEK he would do so if he could bring out his family. Although military personnel are not



Alaskan Stations Track Discoverer Satellite

Stations in Kodiak (top left) and Annette Island (top right), Alaska, are set up to track Advanced Research Projects Agency Discoverer satellites. Radar control panel operation is shown at left below; satellite telemetry signals are monitored at right below. Philco personnel staff the stations under direction of Lockheed Missiles and Space Division, system manager and prime contractor for Discoverer.



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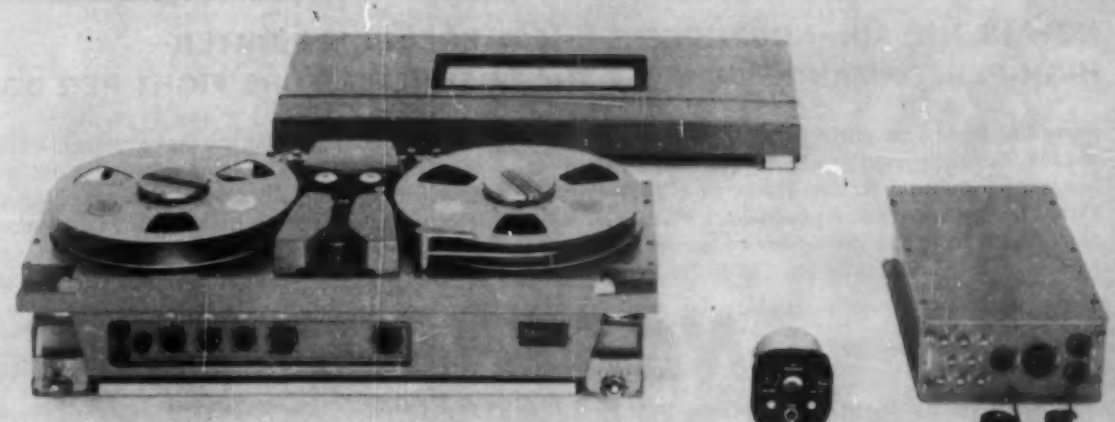

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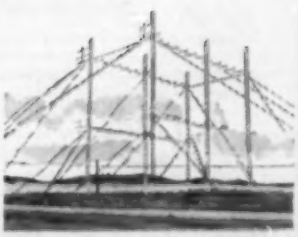

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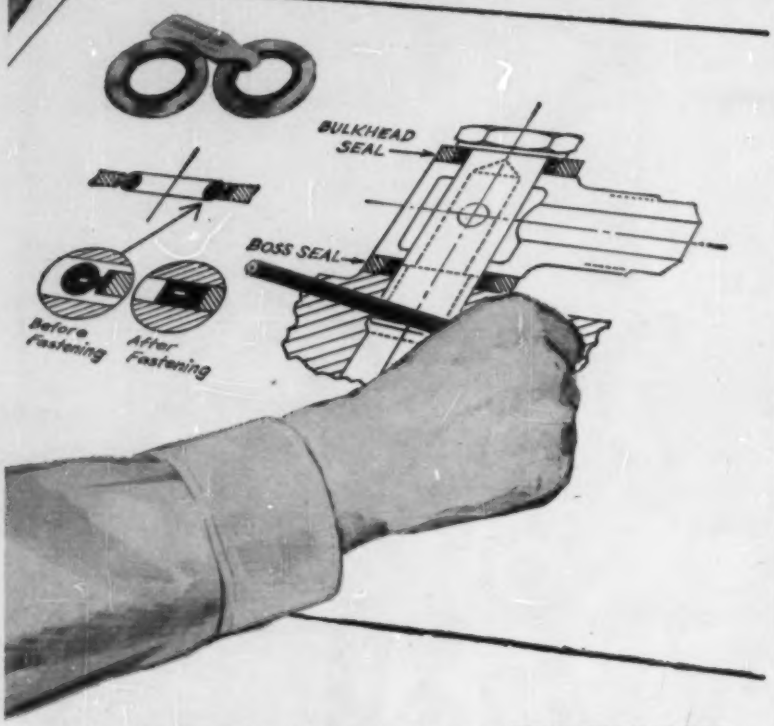

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dissatisfied, this marked difference of outlook testifies to the wisdom of staffing the DEW Line largely with civilians who volunteer for the assignment.

Attrition rate of civilian employes on the line, both voluntary and forced terminations, has averaged less than 2% per month from all causes. Resignations, usually due to inability to stand isolation from family, most frequently occur around the fifth month.

Excellent Relations

The relations between military and civilian personnel appear to be excellent. The USAF/RCAF sector commander has complete authority over the military aspect of the sector stations operations. For example, the decision to place a radar on sector scan instead of conventional 360-deg. surveillance is a military responsibility, according to F. G. Trew, assistant chief of operations for FEC. (Trew is a former colonel in the Army Signals Corps.) However, the assignment of civilian personnel duties or a change in the menu is the responsibility of the station chief, who in turn reports to a sector superintendent—both employes of Federal Electric.

A total of three physicians and three dentists are employed full-time on the line, with modest medical and dental facilities located at each main station. Emergency appendectomy operations have been performed on the line. Normally, however, a patient will be flown back to Montreal, Edmonton or Fairbanks for major medical attention if his condition and the weather permit. Federal Electric also employs six chaplains who conduct religious services along the line and serve as counselors for personal problems.

Maintenance, Overhaul

Each main station, in addition to its role as a data, communications and supply center for the stations in its sector, also serves as a maintenance center. In addition to the approximately 30 men who operate each main station, there are another 40 who serve as roving maintenance specialists, moving into any sector station which has problems beyond the skill or available time of its own personnel.

Each main and auxiliary station has equipment and facilities for performing routine maintenance and repair of electronics equipment, vehicles and machinery. The ITT Electronic Service Co. (ITTESCO) of Montreal tours the line at regular intervals with standards designed to recalibrate the secondary standards instruments located at each main station.

To perform major overhaul of vehicles and machinery, depots have been set up at Fox Basin and Barter Island main stations to serve the eastern and western halves of the line. Overhaul

of electronics equipment, which can be broken down into small, portable subassemblies is performed by ITTESCO in Montreal or by another ITT group in Anchorage, Alaska, which also handles similar work for USAF's White Alice communications network in Alaska.

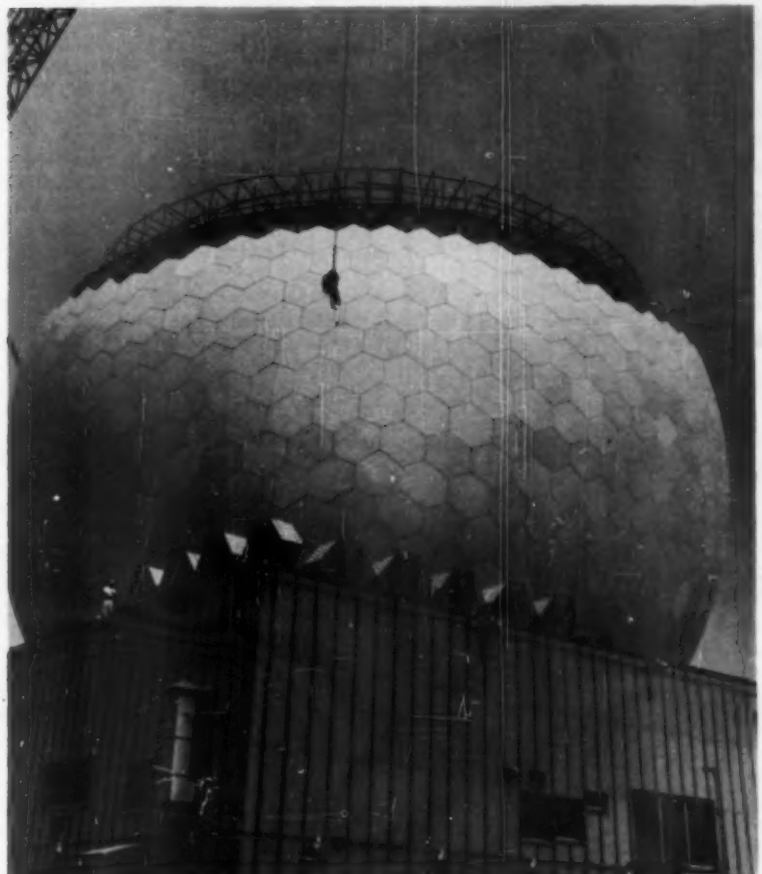
The long, harsh Arctic winter leaves in its wake a considerable amount of station repair and maintenance which must be accomplished in a few months of moderate weather. (During AVIATION WEEK's mid-July visit, temperature was in the sixties and quite pleasant during sunny days; but when the sky was overcast, temperature dropped to near freezing and a strong wind made a warm jacket necessary for comfort.)

Gravel landing strips and roads must be regraded and leveled. Station buildings and antenna towers must be repainted. In the small intermediate stations the original diesel-electric generators are being replaced with more dependable models. Additional warehouses also are being constructed. Some of the temporary buildings, hastily put up to house construction workers when DEW Line was being built, are being made into more hospitable living quarters to house the influx of extra workers brought in each summer to unload the supplies from the annual sea lift.

Although the summer months are busy ones, they do provide DEW Line personnel with the opportunity to fish in virgin streams and, in Alaska, to hunt. (Hunting is forbidden in Canadian sectors in order to prevent depletion of game which Eskimos need for survival.)

A few of the men use their spare time for prospecting. If any lucky strikes have been made to date, they are closely guarded secrets.

(Ed. Note: For earlier stories on DEW Line, see Aviation Week, Sept. 16, 1957, p. 100; April 16, 1956, p. 62.)



Prototype BMEWS Radome Assembled at RCA Plant

Radio Corp. of America missile-tracking equipment for Air Force's Ballistic Missile Early Warning System (BMEWS) will be tested in prototype structure being assembled next to RCA's Missile and Surface Radar Plant, Moorestown, N. J. RCA is prime contractor of BMEWS program. Dome, 140 ft. in dia., will protect radar antennas from weather. Goodyear Aircraft Corp. fabricated dome of paper pressed into honeycomb design and faced with plastic-impregnated glass fiber.

It's a new automatic flight control system.

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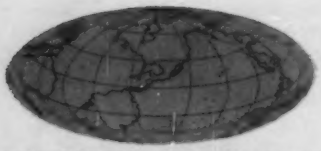
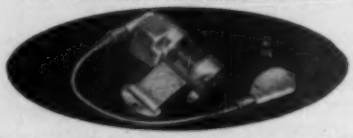


TODAY ON JET AIRLINERS* THE WIDE WORLD OVER...



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Process May Raise Diode Heat Limits

Menlo Park, Calif.—Process for preparation of high temperature semiconductors has been developed by Stanford Research Institute's Ceramics Technology Group, consisting of a method to produce high-purity, single crystals of silicon carbide, which promises to raise the temperature limits for transistor and diode operation from 400F to about 1,800F.

Under a subcontract from the Navy Bureau of Ships and the Shockley Transistor Corp., Stanford scientists began work on the process. By modifying a standard crystal-pulling furnace, pure silicon is melted in a carbon receptacle. Carbon of the crucible diffuses into the molten silicon and saturates solution.

A "cool spot" is produced in one area of the solution by careful temperature control, resulting in a localized area of supersaturated solution from which silicon carbide crystals can be grown.

Present Stanford Research Institute crystals are too small to be commercially usable, but the process appears sufficiently promising that the electronic warfare and parts branch of the Navy Bureau of Ships has contracted for funds to extend the work another year. Stanford Research Institute plans to work with such variables as temperatures, temperature gradients and crucible design to find optimum conditions for growing large crystals.

Expansions, Changes In Avionics Industry

Halex, Inc., El Segundo, Calif., is the name of a newly formed company which will specialize in molecular electronics using a process of depositing thin films of conductive, semi-conductive and resistive materials to form electronic circuits. Company president is Harold R. Larsen, former vice president of Servomechanisms, Inc.

Other recently announced changes, mergers and expansions in the avionics field include:

• **Victoreen Instrument Co.** and **Tenney Engineering, Inc.**, will merge to become Victoreen-Tenney Corp. Victoreen produces radiation monitoring and control equipment. Tenney produces environmental test chambers. Combined sales of the two companies is expected to reach about $15 million this year. Several Tenney officials will join the board of the combined company and share in officerships of the combined firm.

• **Benson-Lehner Corp.**, Los Angeles, manufacturer of data processing equipment, has acquired **Data Services, Inc.**,

Ferrite Magnetic Computer Element

Biax, a tiny ferrite magnetic computer element can be used either as a flip-flop or storage element. The new device, developed by Aeronutronic Division of Ford Motor Co., can be operated at speeds up to 20 mc. at temperatures up to 260F. Each element measures only 50 x 50 x 85 mils. Principle of operation is that of flux interference between orthogonal magnetic fields. Two 20-mil square holes in each element are at right angles to one another. The flux interference takes place in the magnetic material between the holes. Because holes are at right angles, no normal magnetic coupling occurs between conductors passing through the two holes. By controlling spacing between the holes, the flux interference technique can be made either destructive or non-destructive, for flip-flop or storage use. Photo at right shows a storage array of 300 BIAX computer elements.

Tarzana, Calif. Miss Dorothy Blaney, founder and former president of the new subsidiary will remain as the technical consultant, while Miss Diana C. Fortine, general manager of the new acquisition, will remain in the same post.

• **Dynatronics, Inc.**, Orlando, Fla., has moved into a new 21,000 sq. ft. plant at Highway 17-92. The company is negotiating for additional space for anticipated future expansion. The new facility includes a fully instrumented antenna range.

• **Arnoux Corp.**, West Los Angeles, has acquired common stock and personnel of **Instrol, Inc.**, Santa Barbara, manufacturer of transducers. Arnoux, which produces telemetry and instrumentation equipment, will operate the new acquisition at its present location, pending a decision as to whether to consolidate with the parent company.

• **ACDC Electronics, Inc.**, Burbank, Calif., has acquired **Pan-Air Electronics Corp.**, also of Burbank, which produces aircraft control panels and assemblies. The new acquisition has been moved to ACDC's plant at 2979 No. Ontario St.

• **Telemeter Magnetics, Inc.** will move to a new 70,000 sq. ft. facility in Culver City, Calif. in October at 9937-41 Jefferson Blvd. Present location in West Los Angeles will be retained for the company's Components Division which makes ferrite cores, storage arrays and other components.

• **Hazeltine Corp.**, Little Neck, N. Y. has acquired **Wheeler Laboratories, Inc.** through a stock transfer. Mr. H. A. Wheeler, founder, remains as head of the new Hazeltine subsidiary, which specializes in antennas and microwaves. Hazeltine calls the move the "first phase of a major expansion program." Earlier the company had purchased the former Civil Aeronautics Administration Technical Development Center at Indianapolis and set it up as a company engineering facility.

• **Raytheon** will construct a 100-ft. long modulator for testing super-power microwave tubes at its Spencer Laboratory in Burlington, Mass. Raytheon says the new modulator will be the world's largest.

• **Missile Systems Corp.** has acquired **Ling Systems, Inc.**, North Hollywood, Calif.

FILTER CENTER

▶ **USAF Blueprints Nav-Aids Plan**—Air Force's future plans for developing navigation and landing aids, identified as 431-L, revised to reflect the new role of Federal Aviation Agency, is now available from Commander, Detachment No. 1, Air Research and Development Command, Wright-Patterson AFB, Dayton, Ohio.

▶ **SAFTAC To Replace RAPCON**—Air Force's Semi-Automatic Facility for Terminal Air Control (SAFTAC), new facility proposed as replacement for

It's a new inertial navigation system.

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A-C Rotovalves may be your answer. Their full-line opening offers no obstruction to flow. They may be designed to give you extremely close control of closing time. Positive closure gives completely tight shutoff against either pressure or vacuum.

If you have a fluid control problem, A-C offers you a broad background of specialized valve engineering and application skills. To find out more about how we might assist you, contact your nearest A-C valve representative, or write Allis-Chalmers, Hydraulic Division, York, Pa.

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Hydraulic Turbines & Accessories • Pump-Turbines • Pumps • Liquid Heaters
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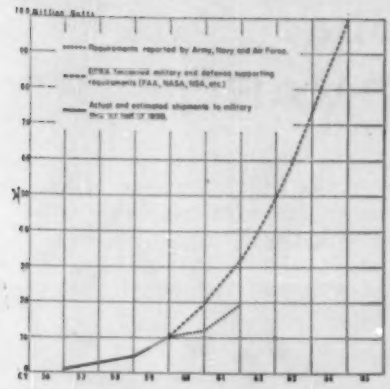

Transistor Trend

Number of transistors required for electronic equipment procured by Defense Department, Federal Aviation Agency and National Aeronautics and Space Administration is shown above, based on an estimate prepared by Electronics Production Resources Agency. The trend line (heavy-broken) assumes that budget for defense, space and aviation will remain at approximately the present level.

Radar Approach and Control center (RAPCON), has been found in need of improvement during Air Research and Development Command evaluation. Additional features sought include electronic counter-countermeasures capability, data link compatibility, and more use of modular construction to provide increased mobility.

▶**RADC Exodus**—Several top civilian engineers and scientists have recently left Rome Air Development Center to take posts in industry. Opportunity for greater financial return is one major factor. Another is concern over RADC's future in the planned Air Research and Development Command reorganization. Most recent departure is Dr. Joseph H. Vogelman, former technical director for communications at RADC, who left to become director of research and development for Dynamic Electronics-New York, Inc.

▶**Radio Corp. of America** will produce AN/UPS-1 transportable search radars for Marine Corps under an $11,226,174 Navy Bureau of Ships contract. Six-man team can assemble the system, comprising 11 packages, and have it operable in 30 min. to search for enemy aircraft.

▶**Airlines Set SSB Standards**—Arinc's Airlines Electronic Engineering Committee (AEEC) has agreed upon airline standards for single sideband communications. Arinc specification calls for receivers with sufficient stability to operate on a suppressed-carrier type of SSB and with capability of adding automatic frequency control provision later if it proves necessary to use a floating-carrier SSB transmitter for data link. The action does not preclude use of Kahn compatible single sideband (CSSB) transmitter inasmuch as the receiver can handle such transmissions as well as the fully suppressed carrier transmissions.

▶**ITT Shows Parametric Amplifier**—Parametric amplifier which enabled Army's Redstone Arsenal tracking equipment to follow Pioneer IV space probe out to a distance of 215,000 mi., was displayed by ITT Laboratories at Army Assn. convention in Washington. Similar amplifier, tested in the longest over-the-horizon tropospheric scatter link in the Alaskan White Alice communication system, operated without a single outage for 24 days during March and April, the worst months of the year for scatter propagation, company says. New amplifier extends effective tropo system range from 250 to 350 mi., or reduces amount of transmitter power required by 90% for same range, company says.

▶**Signed On Dotted Line**—Major contracts recently announced by avionics manufacturers include the following:

• **Epsco-West,** Anaheim, Calif., $240,000 from Boeing Airplane Co. for high-speed digital data system for structural testing of aircraft.

• **Kearfott Co.,** Little Falls, N. J., $4.5 million from Boeing Pilotless Aircraft Division, for unlimited-attitude coordinate converter systems for use with long-range Bomarc pilotless interceptor.

• **Telecomputing Corp.,** Los Angeles, $330,000 in contracts from Navy Aviation Supply Office for radar test equipment and spare parts. Work will be performed by Brubaker Electronics, Inc., subsidiary, of Culver City, Calif.

• **Consolidated Avionics Corp.,** Westbury, N. Y., $75,000 from Boeing Airplane Co. for data reduction system to convert frequency or amplitude modulated telemetry data into digital form for preparing punched cards. Company also reports a $350,000 award from General Electric for automatic test equipment to check components.

• **HRB-Singer, Inc.,** State College, Pa., $2.4 million contract for 17 infrared surveillance systems from Army Signal Supply Agency. Company also reports a $266,430 contract for operation analysis studies for the Marine Corps.

• **Friez Instrument Division of Bendix Aviation,** Baltimore, $2.5 million for manufacture of 125,000 airborne meteorological radiosondes for Army Signal Corps and U.S. Weather Bureau.

• **Ryan Aeronautical,** San Diego, $1.9 million for spare parts and support equipment for APN-122(V) doppler radar navigators from Navy.

It's a new transistorized magnetic control.

This one works . . but not the right way. Maybe you could lend us a hand in exchange for things like employee benefits and GPTL*

General Electric's **ARMAMENT AND CONTROL SECTION** in Johnson City (Binghamton) New York, has 14 openings for men with degrees and/or experience in mechanical engineering, electrical (electronics) engineering, mathematics and physics.

Some of the product areas include transistor and magnetic controls (none like the asteroid-pulling device illustrated), analog and digital computers. Career position openings include project leaders, technical writers, engineers in development, circuitry design, packaging, stress and vibration, systems, quality control and others.

***General Electric has the right combination for developing your career potential.* *Good Place To Live (*ask the Chamber of Commerce*).**

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Mr. R.C. McConnell, Div. B221-4
Armament and Control Section
General Electric Company
600 Main Street
Johnson City, New York

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Degree (year).....
Address.....
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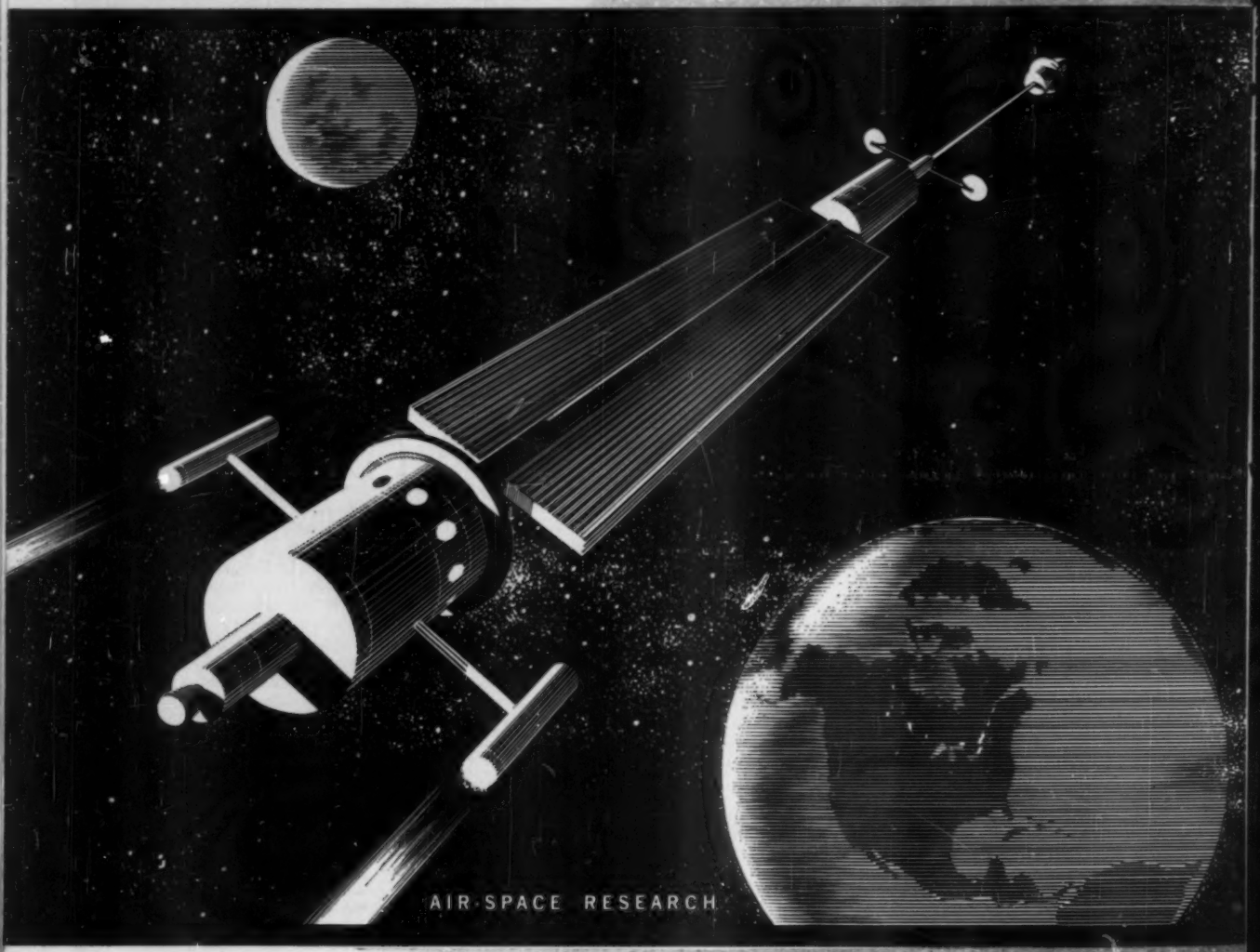
ARMAMENT AND CONTROL SECTION
GENERAL ELECTRIC
JOHNSON CITY, NEW YORK

New Concepts for the Space Age
Mark 15 Years of Progress by MARQUARDT

When founded in 1944, Marquardt was an organization devoted exclusively to research and development of the ramjet propulsion principle. Today, in its fifteenth year, the Corporation employs more than 5,000 in the creation and exploration of new concepts for the space age. Marquardt is now diversified, operating in five basic areas—all primarily related to the search for earlier and ever more effective solutions to space-age problems.



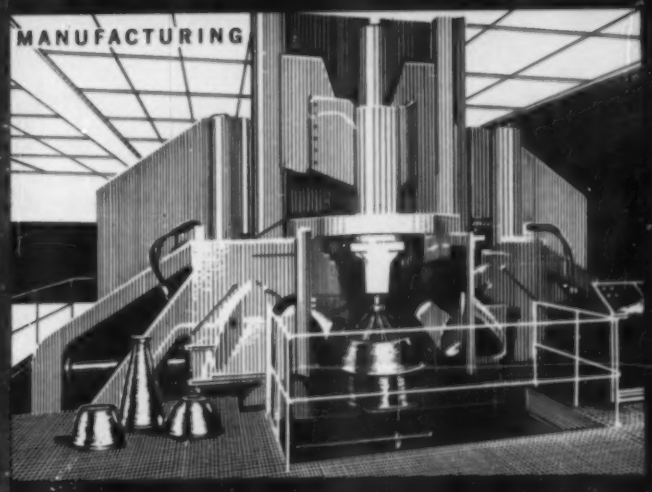
NEW CONCEPTS IN AIR-SPACE RESEARCH spring from ASTRO—Marquardt's Air-Space Travel Research Organization—where studies of an ionic rocket capable of powering future space vehicles are in progress. Other imaginative ASTRO studies span a broad spectrum including high-energy fuels, exotic materials, nuclear powerplants, advanced optics, cryogenics, space medicine, communications and guidance.

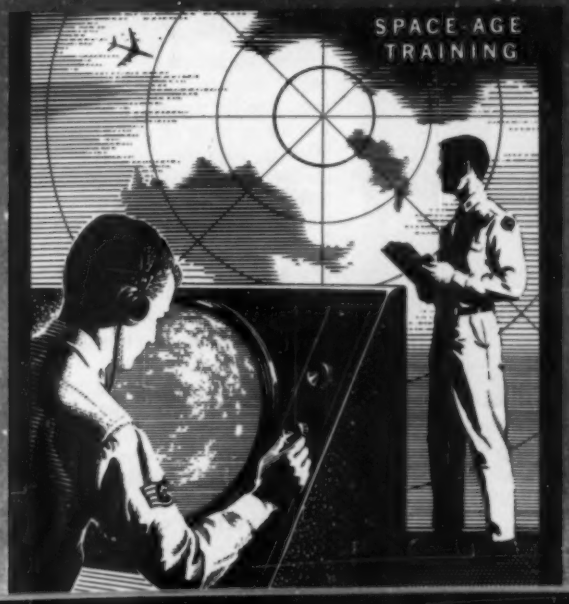
NEW CONCEPTS IN POWER SYSTEMS are in the making at Marquardt's Power Systems Group. Within the Group, Propulsion Division is engaged in continuing studies of a Hyperjet (rocket-ramjet) configuration capable of lifting future satellites from launch pad to upper atmosphere. Controls and Accessories Division is currently developing attitude controls for reconnaissance satellites, while Test Division is capable of ground-testing space-age hardware.

NEW CONCEPTS IN MANUFACTURING are typified by the first-of-its-kind Hufford Spin-Forge at Marquardt's Ogden Division. This 250-ton machine will contribute advances in space-age metal working state-of-the-art, while augmenting the Division's production of supersonic ramjet engines for the Boeing Bomarc IM-99.

NEW CONCEPTS IN SPACE-AGE TRAINING are an important product of Marquardt's Pomona Division—creators of a unique system which realistically simulates a 4,000 mile mission on an 8-foot map. The system will ground-train air and spacemen without risk and at great savings in cost.

NEW CONCEPTS IN RESEARCH ROCKETRY and instrumentation come from Cooper Development Corporation, a Marquardt subsidiary. Cooper has contributed to programs including Explorer and Sunflare projects, and Falling Sphere—is now at work on Project Mercury.

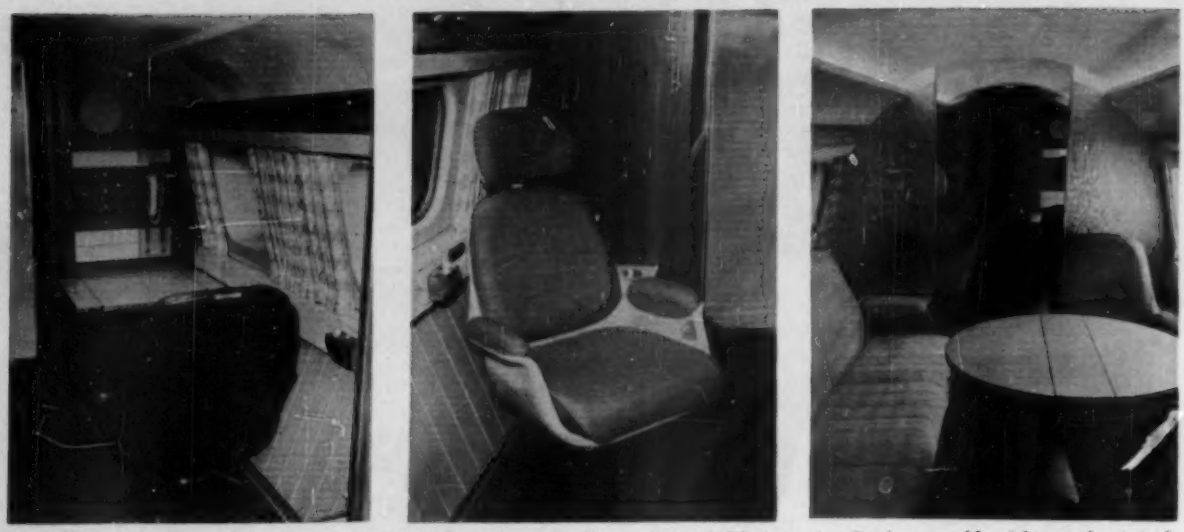




Engineers and scientists capable of making contributions in these and related areas are invited to write The Marquardt Corporation, Corporate Offices, 16555 Saticoy Street, Van Nuys, California, or

THE Marquardt CORPORATION

POWER SYSTEMS GROUP AND ASTRO
16555 Saticoy Street, Van Nuys, California
POMONA DIVISION
2709 North Garey Avenue, Pomona, California
OGDEN DIVISION
1000 West 33rd Street, Ogden, Utah
SUBSIDIARY: COOPER DEVELOPMENT CORPORATION
2626 South Peck Road, Monrovia, California



PEDESTAL-mounted armchairs in executive cabin demonstrator recline, swivel and slide in tracks. Conference table, right, can be stowed.

Mobile Mockup Displays JetStar Interior

New York—Prospective customers will get their first look at the Henry Dreyfuss-designed executive interior of the Lockheed JetStar when a mobile demonstrator begins a national tour in October.

First stop on the itinerary will be the National Business Aircraft Assn. meeting in Minneapolis, Minn.

The mockup, called a mobile executive cabin demonstrator by Lockheed, was constructed by the L. B. Smith Aircraft Corp., Miami, Fla. The two JetStar prototypes are flying with standard interiors, and will keep these interiors after conversion to four Pratt & Whitney JT12 engines, to be completed on the first plane in late December of this year.

Production versions of the $1.2 million aircraft, slated for rollout in July, 1960, will have custom interiors, the mockup being a suggested cabin configuration.

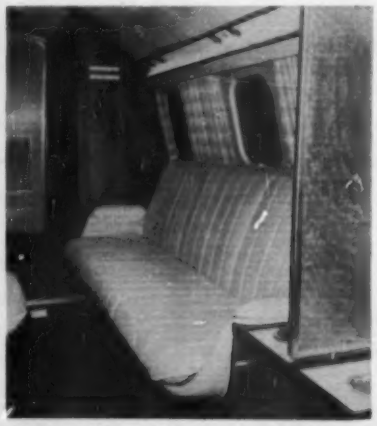
The Dreyfuss-designed interior divides the passenger cabin into two equal-size compartments. The forward compartment contains a three-seat sofa and two molded glass fiber pedestal-mounted armchairs. A round table can be folded and stowed.

The after compartment contains three armchairs and a desk. In addition to the desk, each chair and section of the sofa has a nearby work surface to hold reading matter or refreshments. The eight-passenger seating arrangement is flexible and can be changed to meet customer requirements.

A galley is demonstrated in the mobile unit, as is a lavatory located aft. Two closets for coats are provided, along with a storage area for luggage.

Color scheme of the mockup includes beige, tan and off-white with bright red-orange accents. The glass fiber seat shells are covered with natural leather with tweed cushions. Floor covering is in black and brown stripes, and wall panels are teak.

The seats in the JetStar demonstrator are the outcome of a Dreyfuss study performed for the Lockheed Electra with the added refinements that are made possible by the additional room and individual seating provided by the executive aircraft. Medical consultant on the project was Dr. Janet Travell of the Cornell University Medical College.



THREE-SEAT sofa is in forward compartment. Windows are polarized, thereby permitting the regulation of light passage.

The study, in addition to sizing the seats to fit people from the tallest (97.5 percentile) to the shortest (2.5 percentile) destroys many popular ideas about seating. Researchers found that a flat, firmly cushioned surface provides more restful seating by concentrating body weight on the ischial tuberosities (pelvic points) rather than distributing the weight over a broad area.

Following the theory that no position is comfortable if it must be maintained for extended periods, the seats are designed to permit a maximum number of changes in body position. The backs of the seats are slightly rounded to support the back from the sides and are curved to fit the spine, particularly the lumbar region of the lower back. Two other important considerations were found to be the angle at the knee and the waist, both of which should exceed 90 deg., and the reduction of pressure at the thigh which tends to pinch off arterial flow to the legs.

The chairs, mounted on a pedestal, recline through a 24 deg. arc, swivel and slide on tracks. Chairs normally will be facing forward for all takeoffs and landings. Photos of the mockup do not show the seat belts which will be built into all seats.

The head rests are detachable and can be stowed when not desired; however, they will normally be left in place as they permit sleeping in the chairs. Also detachable are foot rests.

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...for quiet, sure starts on their new electra/JETS

For their fleet of *electra/JETS*, Western Airlines, "America's Senior Airline," has selected Pre-Flite Air-Torq pneumatic starters. Simplicity of design (only five major components), proven operating range (little or no warm-up from –45°F. to 130°F.), plus low maintenance cost make Air-Torq the ideal pneumatic starter for more and more jet aircraft. Now also in daily use for the DC-8, F-101, A3J, and Boeing 707.

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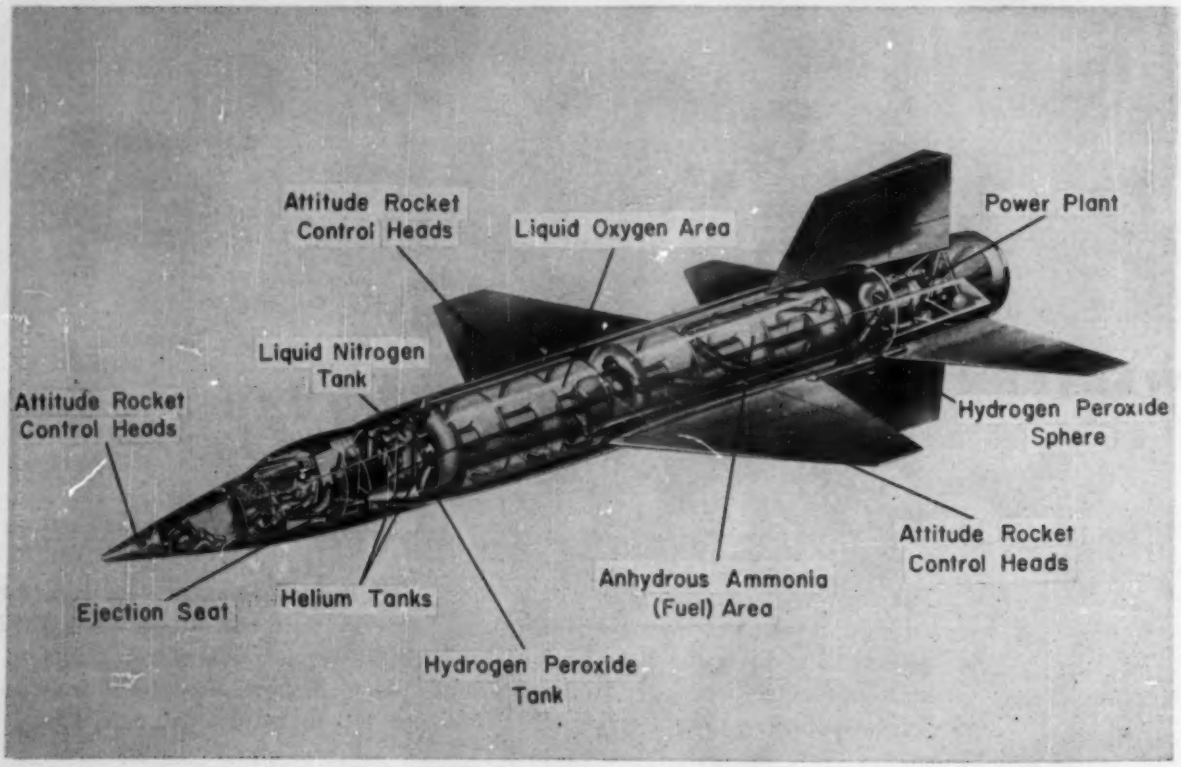
Shown during a preflight check is the second X-15, scheduled to make the first powered flight (AW Aug 17, p. 39). First X-15 is scheduled to be fitted out and ready for power run by September or October. First powered flights will be with two Reaction Motors 12,000-lb.-thrust XLR11-RM-5 engines. The 50,000-lb.-plus thrust Reaction Motors XLR99-RM-1 engines will be installed later.

X-15 Glide Tests Lead to First Powered Flight



Liquid oxygen and ammonia fuel the X-15's 50,000-lb.-thrust Reaction Motors XLR99-RM-1 rocket engine. Propellant system is pressurized by liquid helium, while liquid nitrogen is used for air conditioning and environmental pressurization. Steam for attitude control rockets and auxiliary power turbine is generated by a hydrogen peroxide-catalyst reaction.

North American test pilot Scott Crossfield readies X-15 for glide test. Free flight test drops over Edwards Air Force Base, Calif., began early in June (AW June 15, p. 29). Tip-tanked chase plane standing watch off right wing of Boeing B-52 is North American F-100.

Navy Contracts

Washington—Following is a list of unclassified contracts for $25,000 and over as released by U. S. Navy contracting offices:

DEPARTMENT OF THE NAVY, Bureau of Aeronautics, Washington 25, D. C.

Southwest Research Institute, San Antonio, Tex., conduct program to detect latent fatigue damage in metals and alloys, NOas 59-6202-c(AE-41-4741-9), $58,888.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., 175 ea., indicator, attitude, spherical, direct reading, fast erecting, electric gyro self-contained in accordance with Spec. MIL-I-21203(Aer), NOas 59-0237-f(PD-42-2364-59), $720,189.

Fenwal, Inc., Ashland, Mass., conduct a preliminary evaluation to furnish one (1) prototype package of the contractor's multipoint tactical missile monitoring system, NOas 59-4230-c(AV-41-2953-9), $67,513.

Creative Arts Studio, Inc., Washington, D. C., preparation of master shooting script with a complete storyboard and production of one 16mm. Ektachrome, motion picture with sound, NOas 59-8069-f(PH-5-3491-9), $35,076.

J. W. Fecker, Inc., subsidiary of American Optical Co., Pittsburgh, Pa., design, fabricate and furnish an aircraft optical viewing device with rapid closure capability, NOas 59-4218-f(AE-16-4752-9), $50,000.

Kearfott Co., Inc., Clifton, N. J., design, fabricate, evaluate and furnish two models of a two-axis gas bearing gyroscope, NOas 59-6218-c(AV-32,2956-9), $95,504.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J., restoration, rehabilitation, modernization and modification of government-owned machine tools and capital equipment, NOas 59-0014-c(IP-33-4395-59), $37,100.

Temco Aircraft Corp., Dallas, Tex., restoration, rehabilitation, modernization and modification of government-owned tools and other capital equipment, NOas 59-0017-c (IP-12-4401-59), $30,000.

Sperry Gyroscope Co. Division, Sperry Rand Corp., Sunnyvale, Calif., research and development of missile-aircraft interference study, NOas 59-6140-c(AD-31-4941-59). $39,085.

Lockheed Aircraft Corp., Burbank, Calif., six man-months of flight engineering services, overseas only, in the latest procedures and techniques on the WV-2 program, NOas 59-0286-s(MA-60-1003-59), $34,000.

Hamilton Standard Division, United Aircraft Corp., Windsor Locks, Conn., spare propellers to support the P5M-2 aircraft in accordance with Spec. MIL-P-5447A(ASG) except paragraph 3.3.2 is hereby deleted, NOas 59-0243-f(PD-41-1946-59), $2,196,613.

Universal Cyclops Steel Corp., Bridgeville, Pa., experimental study of fabrication methods and procedures for producing molybdenum alloys, NOas 59-6142-c(AE-41-4746-59), $467,811.

RD-HR Corp., New York, preparation of master shooting script with partial storyboard and production of one 35mm. Eastman color motion picture with sound in accordance with Spec. joint Army-Navy JAN-P-55 and amendment No. 1 thereto, NOas 59-4242-f(PH-51-3509-9), $43,638.

Magnetic Amplifiers, Inc., New York, N. Y., design, develop, fabricate and furnish one prototype and nine preproduction missile power supply units, 28 volt d.c. and 115/200 volt a.c. at 3,200 cps., in accordance with Spec. MIL-P-21487(Aer) with the exception that the requirements of paragraph 3.1 and 6.3 are waived, NOas 59-6133-c (AE-81-4666-59), $53,854.

Goodyear Aircraft Corp., Akron, Ohio, installation of new ASW equipment in ZPG-2 airships, NOas 59-0315(MA-33-5146-9), $228,800.

Military Products Division, Entwistle Manufacturing Corp., Providence, R. I., design, fabricate, develop and furnish pressure suit ventilating units, NOas 59-4232-c (MA-51-427-59), $94,384.

Sperry Gyroscope Co. Division, Sperry Rand Corp., Great Neck, L. I., N. Y., special tools, jigs, fixtures and test equipment for Sparrow I missiles procured under Letter of Intent 51-313, NOas 59-0299-f(IP-31-4533-58), $400,983.

Columbus Division, North American Aviation, Inc., Columbus, Ohio, furnish materials and services necessary for the construction, rehabilitation, replacement and modernization of certain civil works, NOas 59-0030-c(IP-31-4414-9), $877,000.

Grumman Aircraft Engineering Corp., Bethpage, L. I., N. Y., replacement of government-owned machine tools and other capital equipment, NOas 59-0035-c(IP-3-4428-9), $2,502,859.

General Electric Co., Schenectady, N. Y., fabricate and furnish self-adaptive type automatic flight control systems, NOas 59-6078-c(AV-37-2715-59), $231,982.

Transfilm, Inc., New York, preparation of the master shooting script and production of one (1) 16mm. Ektachrome motion picture with sound in accordance with joint Army-Navy Spec. JAN-P-55 and amendment No. 1 thereto, NOas 59-8075-f(PR-5-3502-9), $38,166.

Marks Polarized Corp., Whitestone, L. I., N. Y., services and materials to develop electro-optical and photochromatic systems, NOas 59-6256-c(AE-44-4774-9), $70,509.

Chromalloy Corp., White Plains, N. Y., research and development facilities and personnel to conduct a study of explosive forming of refractory metals, NOas 59-6265-cAE-41-4773-9), $142,997.

Rias Division, The Martin Co., Baltimore, Md., conduct a study of the mechanism of dispersion hardening in various alloys, NOas 59-6230-c(AE-41-4765-9), $25,948.

New England Materials Laboratory, Inc., Medford, Mass., investigation of the feasibility of improving the high-temperature strength of refractory metals by internal oxidation of alloy powders, NOas 59-6223-c (AE-41-4761-9), $42,857.

E. W. Bliss, Co., Philadelphia, Pa., design, manufacture, furnish drawings, install and test expeditionary catapult and arresting gear system, in accordance with contractor's drawing 52-W-662, NOas 59-6268-c(SI-32-4588-59), $527,453.

Aeroprojects, Inc., West Chester, Pa., develop aerosol type metal spraying equipment, NOas 59-6247-c(AE-41-4768-9), $57,-950.

Cryogenic Engineering Co., Denver, Colo., design, develop, fabricate and furnish one (1) liquid helium tank semi-trailer in accordance with BuAer Spec. for liquid helium tank highway semi-trailer, NOas 59-4262-c (SE-35-3899-9), $82,340.

House Glass Corp., Point Marion, Pa., develop an ultra-high strength vitreous fiber, NOas 59-6258-c(AE-44-4763-9), $72,794.

Logetronics, Inc., Alexandria, Va., continuous strip printers, model SP 10/70, optics, cassettes and spare parts kits, NOas 59-4265-f(PH-31-3309-9), $98,962.

Electro-Seal Corp., Des Plaines, Ill., 2,325 ea., Aero 7A bomb shackle releases in accordance with contractor's drawing C2042-E11-1 and Spec. MIL-R-7864(Aer) and amendment No. 1 thereto, NOas 59-0303-f (PD-42-2276-9), $194,561.

Bell Helicopter Corp., Fort Worth, Tex., bench fatigue testing of model HUL-1 dynamic components, NOas 59-6213-c(AD-23-4943-9), $24,084.

Redco Tool Division, Red Lion Cabinet Co., Red Lion, Pa., modify 30 government-owned portable hydraulic test stands in accordance with BuAer Spec. XMA-75A, NOas 59-4266-c(MA-55-516-9), $55,448.

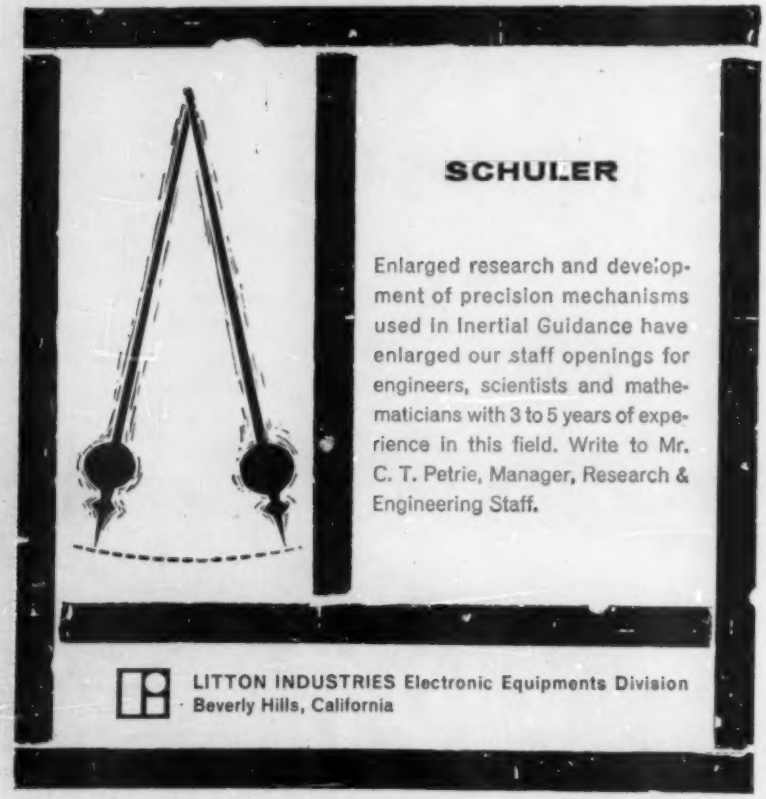
McDonnell Aircraft Corp., St. Louis, Mo., flight demonstration and evaluation program of Model 120 utility cargo helicopter, NOas 59-6195-f(AC-42-4246-9), $89,900.

Seattle Division, Boeing Airplane Co., Seattle, Wash., develop and test ceramic bonded stainless steel structural components, NOas 59-6228-c(AE-44-4724-9), $98,-229.

Aeronutronic Division of Ford Motor Co., Glendale, Calif., additional Pacific Missile Range instrumentation study, NOas 59-6235-c(AV-42-2985-59), $200,000.

Engleman & Co., Inc., Washington, D. C., analyze abstracts of technical reports, NOas 59-6243-c(AD-4-4287-59), $34,386.

Alloyd Research Corp., Watertown, Mass., research on refractory metals, NOas 59-6248-c(AE-41-2766-9), $66,340.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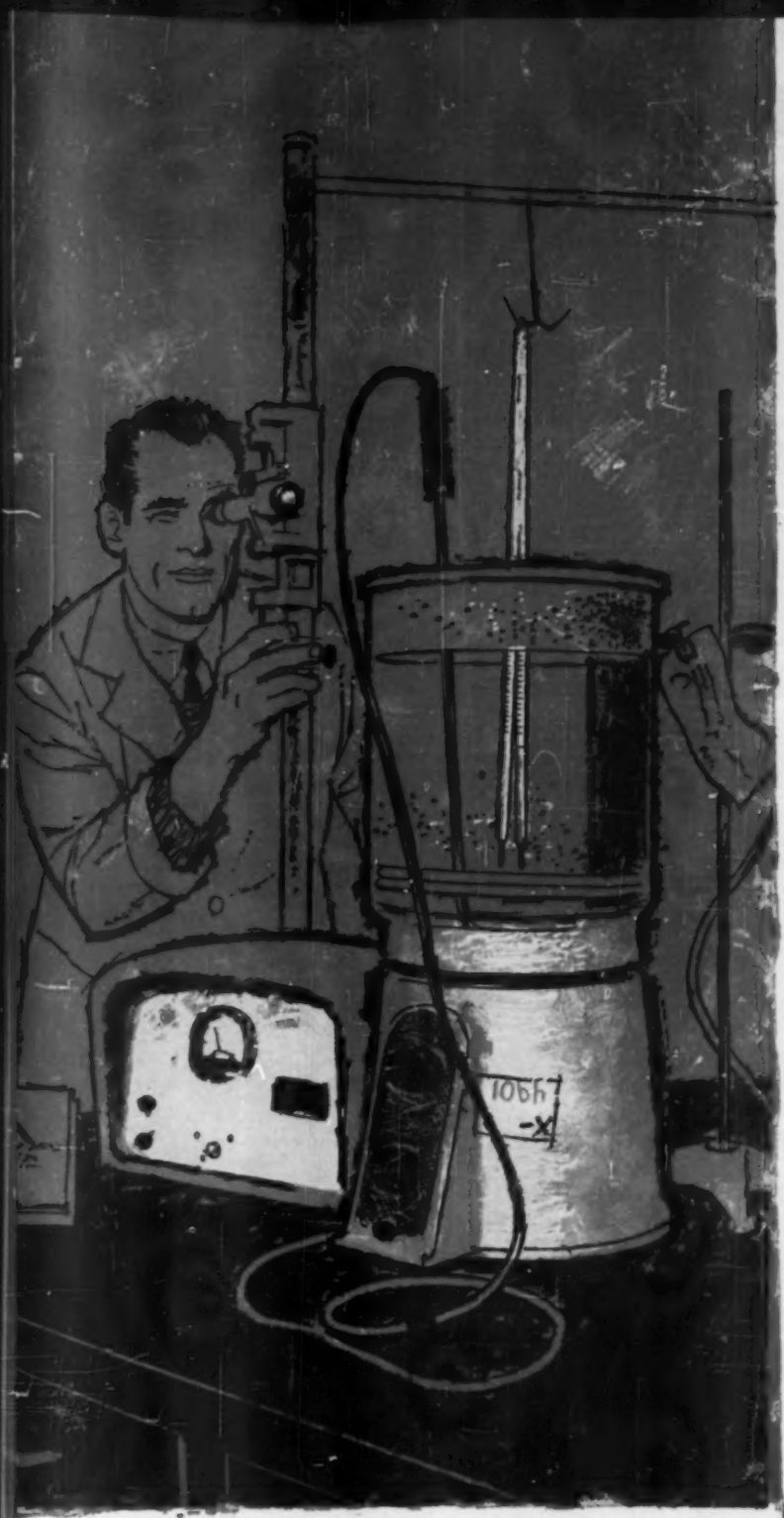
Enlarged research and development of precision mechanisms used in Inertial Guidance have enlarged our staff openings for engineers, scientists and mathematicians with 3 to 5 years of experience in this field. Write to Mr. C. T. Petrie, Manager, Research & Engineering Staff.
LITTON INDUSTRIES Electronic Equipments Division
Beverly Hills, California



At Avco...

SPACE RESEARCH WITH "BUILT-IN" STANDARDS

Today's complex weapons systems require new levels of precision in every subsystem, every component, virtually every part. Primary standards are a point of departure for any research and development program that is to lead to a workable, reliable, modern weapons system.

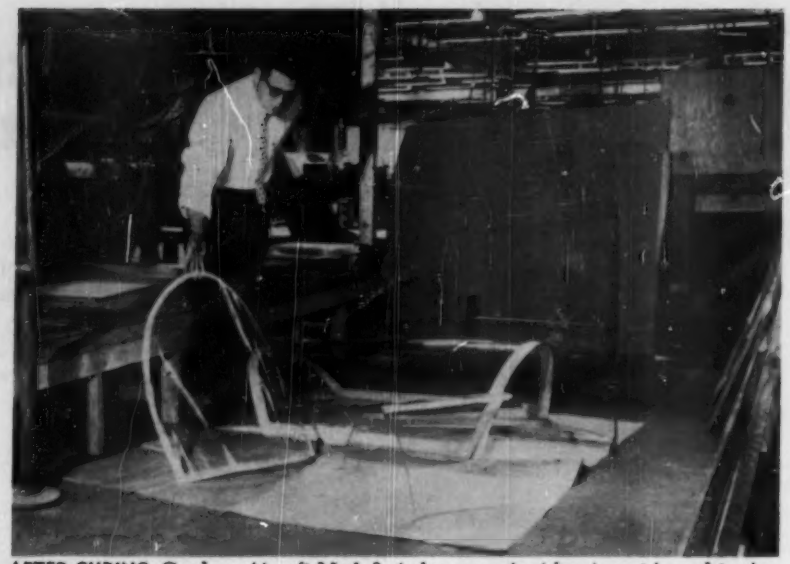
At Avco's Research and Advanced Development Division, scientists and engineers are designing advanced re-entry vehicles and research equipment that will open the door to further advances in space flight. Built into this program are standards laboratories designed to ensure that the requirements of space-age precision will be met.

By "building in" its own reference standards and calibration laboratories, Avco has established a firm base for research and development. The laboratories provide the Avco Research Center with its own primary standards, to which working, secondary standards are regularly compared. These laboratories cover electrical, radio frequency and physical measurement calibration, with secondary calibration laboratories for electrical, electronic and electromechanical measurements.

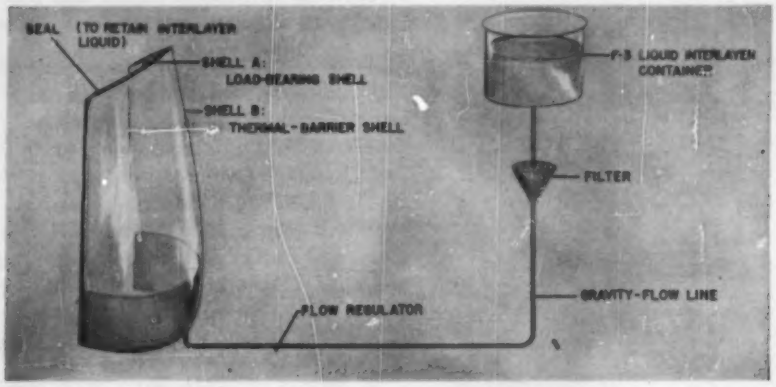
A dynamic program of standards research is carried on within these laboratories to develop tools of measurement that will ensure the even greater reliability required of future weapons systems. This standards research program exemplifies the spirit of scientific support for development programs that is found throughout the division. It is part of an approach that enables scientists and engineers at the Research and Advanced Development Division to benefit from an interchange of information and ideas among all levels and all areas of effort.

Avco
Research & Advanced Development

For information on unusual career opportunities for exceptionally qualified scientists and engineers, write to Scientific and Technical Relations, Avco Research & Advanced Development Division, 201 Lowell Street, Wilmington, Mass.



AFTER CURING, Goodyear Aircraft Mach 3 airplane canopies (above) are trimmed to size, with vinyl spacers being cut off in process. Drawing below shows how fluid resin is cast between curved sheets. Plastic interlayer adheres well to both polyesters and acrylics.



Goodyear Develops Heat-Resisting Mach 3 Aircraft Canopy Material

Akron, Ohio—Goodyear Aircraft Corp. has developed a new high-temperature transparent material for the canopies of Mach 3 aircraft.

Trade-named Thermoshield, it is a three-ply laminated material consisting of an unidentified plastic interlayer sandwiched between a stretched acrylic, load bearing inner layer and a heat resistant polyester outer layer.

The material, according to Goodyear, will extend the temperature limit of conventional stretched acrylic canopies from 230F to 350F, or possibly higher if it proves possible to use glass as the outer thermal barrier layer. In addition, Thermoshield is said to be capable of withstanding thermal shocks up to 600F as well as the impact of a lead-nosed .45 cal. slug fired from 50 ft. away.

Most of the improved characteristics of Thermoshield canopies are credited to the new plastic interlayer. Designated F-3, the interlayer is identified only as a slightly cross-linked resin that can be cast and cured at temperatures below 220F.

This temperature is critical because it is the upper temperature limit for the acrylics which are the most desirable materials for use in the inner load-bearing shells of high-temperature laminated canopies.

Because it is a fluid resin, F-3 can be cast between curved sheets as well as flat ones. In production, the inner and outer canopy shells will be formed independently. Vinyl spacers will be used to separate the edges of the preformed shells and form the specified gap into which the F-3 resin will flow.

AMC Contracts

Wright-Patterson AFB, Ohio—Following is a list of unclassified contracts for $25,000 and over as released by the Air Materiel Command:

Smith, Hinchman, Grylls Associates, Detroit, Mich., architectural and engineering services, title II, (PR PM-8-X-5628; PM-8-X-5627; PM-8-X-5625; PM-8-X-5621; PM-8-X-5617; PM-8-X-5224), $34,863.

Flight Propulsion Division, General Electric Co., Cincinnati, Ohio, 7 ea., YJ79-GE-9 turbojet aircraft engines and data, (PR EP-9-2840-4450), $1,436,100.

Flight Propulsion Division, General Electric Co., Cincinnati, Ohio, 3 ea., YJ79-GE-9 turbojet aircraft engines for service test in connection with B-58 aircraft program, (PR EP-9-2840-4839), $540,529.

The Rainier Co., Inc., Yonkers, N. Y., 612 ea., indicators, ID-351B/ARN (for use with airborne radio navigation systems for the T-37A and Navy aircraft), (PR MA-16A-1048; MIPR R59-1878-111-NOas), $192,168.

Convair Division, General Dynamics Corp., Ft. Worth, Tex., 3 ea., B/RB-58 bomb/navigation trainers and related equipment, (PR SB-9-6900-7318), $1,195,200.

Thomas A. Edison Industries, McGraw Edison Co., West Orange, N. J., 193 ea., indicators, pressure, oil, type MO-3, Aerno 61-2486; 218 ea., transmitters, pressure, oil, type MO-3, Aerno 61-2487; spare parts and data, aircraft usage: C-133A, H-40A and depot spares, (PR's EA-9-05D-4560, EA-9-05D-4561 and MA-9-05D-475), $70,752.

Watkins-Jenkins Co., Palo Alto, Calif., microwave radiating power source program, (PR 08514), $256,278.

Aerial Machine & Tool Corp., Long Island City, N. Y., 30,000 belts, aircraft safety, lap, automatic opening, type MA-5, Aerno 45-1721 for: various jet aircraft, (PR OC-9-03F-13007), $426,000.

Mechanics Research Division, American Machine & Foundry Co., Chicago, Ill., architectural engineering services (for design and modification of AF plant, plant 48, Heath, Ohio, as a standard calibration laboratory), (PR PD-9-S-1089), $124,880.

Hughes Aircraft Co., Culver City, Calif., components of the MG-13 fire control system for the F-101B aircraft (PR's PE-9-11B-4094, PE-9-11B-4281, EG-9-11B-4534, EG-9-11B-4761), $3,363,700.

M. Steinthal & Co., Inc., New York, 105 ea., canopies, ribbon, and 50 ea., deployment bags, (PR 56258), $30,912.

Aeronca Manufacturing Co., Middletown, Ohio, ceramic bonded metal sandwiches, (PR EM-9-RD-6249), $25,042.

All American Engineering Co., Wilmington, Del., aircraft arresting barrier absorber, (PR EM-9-RD-6323 and amendment No. 1), $90,000.

General Precision Laboratory, Inc., Pleasantville, N. Y., components of doppler navigation system, AN/APM-81 and data for: KC-135 and type B-52 aircraft, PR MD-9-16K1-55152), $1,843,944.

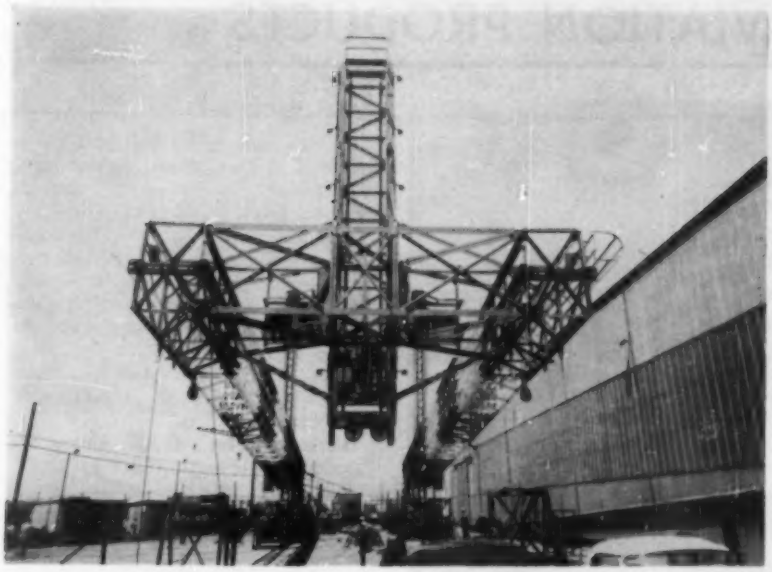
Narmco Industries, Inc., San Diego, Calif., 183 ea., ceramic adhesive panels, (PR EM-9-RD-6251), $40,522.

The Harshaw Chemical Co., Cleveland, Ohio, $33,000 lb. of liquid chlorine trifluoride, (PR EM-9-RD-6322), $67,320.

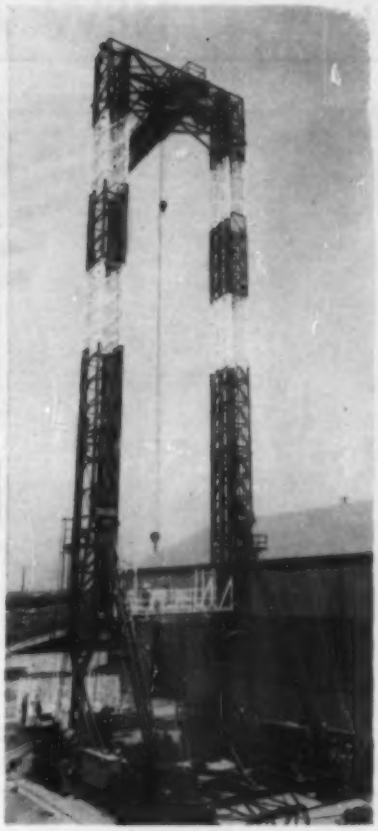
The General Tire & Rubber Co., Akron, Ohio, 1,874 ea., wheel assemblies, nose, 18 x 5.5., Aerno 41-1125 for: F-101 aircraft, IFB 33-600-59-173 (PR 00-9-1630-3246), $74,154.

Industrial & Military Equipment Division, Allen B. DuMont Laboratories, Clifton, N. J., 13 ea., cameras, polaroid, oscillograph-record, DuMont type 302; 11 ea., camera, oscillograph-recorder, DuMont type 321-A and related equipment, (PR 913160-A and amendment No. 1), $26,265.

Hoffman Laboratories Division, Hoffman Electronics Corp., Los Angeles, Calif., various components of radio sets, ARN-21C for use in F-84, F-86, F-100, F-101, B-52, B-66, C-47, C-54, C-130, C-133 and KC-135 (PR's MD-9-16A-35223 and amendments No. 3 and 4, SA-9-FSC-5826-9416 and SA-9-FSC-5895-9418), $90,147.



Tower is assembled at ground level, then erected by built-in power units. The hammerhead crane at top of mast has a 10-ton capacity for erecting or assembling missiles.



Erected tower accommodates 9-ft.-diameter, 135-ft.-high missile. Entire assembly, weighing about 160 tons, rolls on two 12-wheel heavy-duty trailers. Note first access platform being raised by hammerhead crane.

Tower Services Jupiter, Redstone

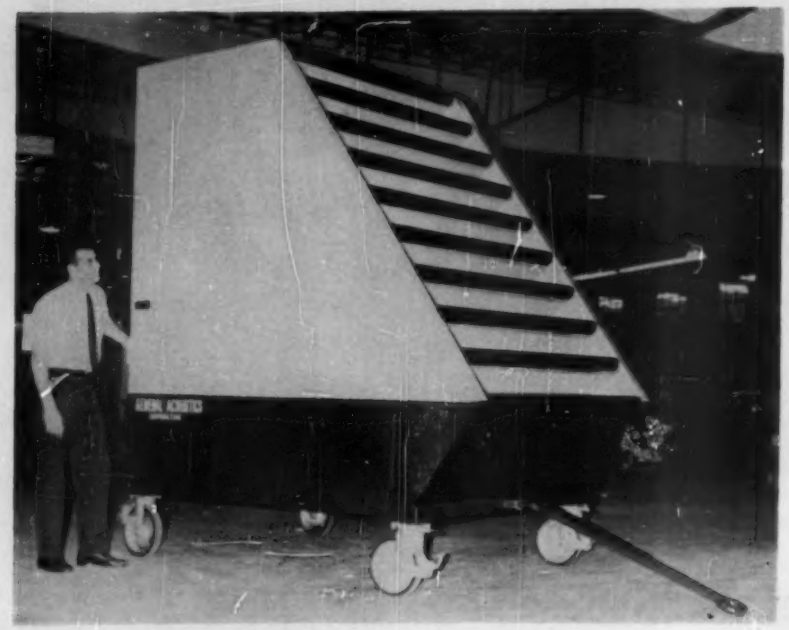
Army-designed Redstone and Jupiter missiles can be rigged for launch with a steerable tower mounted on rubber tires. Tower collapses and stows in 12 trailers and one dolly for over-road transport or for airlift in Douglas C-124 or C-133 cargo aircraft. Built by the Noble Co., Oakland, Calif., for the U. S. Army Ballistic Missile Center, it is intended for use at Cape Canaveral.

Up to six pre-assembled access platforms can be raised after tower erection. Above, five are shown in place.

Tower is positioned by tracer arms fore and aft that follow a guide track, signaling deviations to steering device.

Eight power-operated, 30-ton jacks automatically level tower. Jacks retract when tower sits on wheels.

NEW AVIATION PRODUCTS



Jet Intake Noise Suppressor

Portable jet intake noise suppressor reduces high frequency compressor whine, protects ground personnel from engine intakes, and prevents ingestion of foreign objects. The 2,000 lb. intake suppressor, measuring 9 ft. long, 10 ft. high and 6 ft. wide, is intended for both military, commercial jets. First purchaser of Model AI-59 suppressor is United Air Lines.

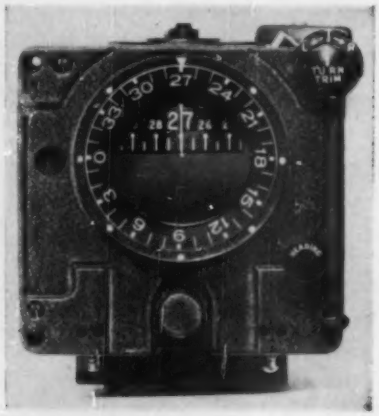
Ejection Selector Valve

Ball-type selector valve permits plane commander of a damaged jet aircraft to control the sequence in which personnel are ejected from the aircraft.

Controlled ejection sequence minimizes danger of collision as crewmen eject.

Valve is of full ball "stacked" design with eight ports controlled through one selector lever. Operating line pressure is 4,500 psi.; valve weight is less than 2 lb.

Koehler Aircraft Products Co., 409 Leo St., Dayton 4, Ohio



Automatic Pilot

Transistorized two-control autopilot provides positive roll and heading control and is FAA approved for most four-place single engine aircraft.

Automatic pilot will make turns of any number of degrees. The two-control model is exactly like the three-control autopilot except for pitch control which can be added at any time. Price of the two-control model is $1,095; with automatic heading selector, price is $1,480.

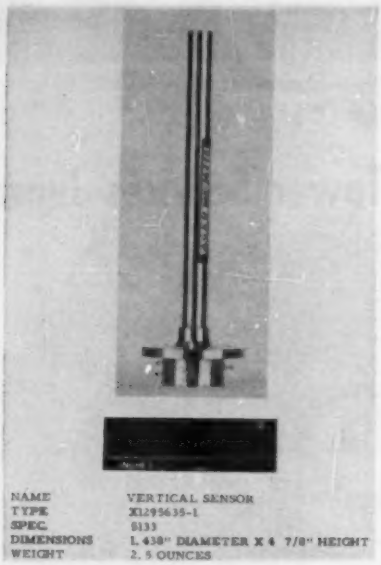
Mitchell Sales Agency, Box 1181, Fort Worth, Tex.

Metal Bellows Seal

Bellows-type mechanical shaft seal is intended to operate in corrosive high-temperature, high-pressure environments on aircraft and missiles.

Seal resists most corrosive bases and acids, both liquids and gases, and provides leakproof sealing of hazardous fluids. The seal will operate at pressures to 1,000 psi., rotational speeds of 36,000 rpm. and at temperatures ranging from −400 to +1,000F. Series AMB seals are available in sizes up to 7 in. shaft diameters.

Turbocraft, Inc., 492 E. Union St., Pasadena, Calif.



Missile Vertical Sensor

Vertical sensing instrument for missiles detects true vertical within 3 min. of arc.

Sensor consists of an iron pendulum suspended in a small tube, 5 in. long, filled with damping fluid. Magnetic pickups spaced 90 deg. apart at the tube bottom detect pendulum deviation from the center position. When excitation is applied (5 v., 400 cps.), the pickups produce a linear output. When the tube is exactly upright, + or − 3 min., the unit is at electrical null. Weight is 2.5 oz.

Eclipse-Pioneer Division, Bendix Aviation Corp., Teterboro, N. J.

Fuel Tank Pressure Regulator

Regulator valve is designed to hold pressures in tanks to within 1/10 lb. despite varying inlet pressures.

Pressure control valve may be adapted

to a variety of sizes and pressure settings from 0 to 300 psig. Full flow is maintained within 2/10 lb. above cracking pressure. Operating temperature range is −65 to 480F. Minor modifications permit the 1 lb. 7 oz. valve to meet conditions of exotic fluids or gases.

Besler Corp., 4053 Harlan St., Emeryville, Oakland 8, Calif.

Radial Instrument Mounting

All-metal instrument mounting is designed for airborne instruments which are not installed on a panel. Mountings are in service on the North American X-15 and the Boeing 707.

Instrument mounts, Models K425 and K710-14, utilize a stainless steel damping material. The stainless steel cushion provides high inherent damping and is unaffected by dust, oil, water or temperature extremes.

Robinson Technical Products, Inc., Teterboro, N. J.

Airborne Cooling Fan

Slotted-blade cooling fan, an outgrowth of research in noise reduction, will be installed on the Republic F-105D fighter bomber. The use of slotted blades extends laminar boundary layer flow over a larger portion of blade surface, permitting higher aerodynamic loading without stall propagation.

The fan provides 450 cfm. of cooling air at total pressure of 22 in. water gage. The component measures 7¼ in. long, weighs 7.8 lb., and has a 2.4 hp. motor which drives a 4-in. impeller at 22,500 rpm. Other models are available for specific user requirements.

Electric Boat Division, General Dynamics Corp., Groton, Conn.

WHAT'S NEW

Reports Available:

The following reports were sponsored by the Office of Technical Services, United States Department of Commerce, Washington 25, D. C.

Development of an Experimental Gas Radiation Pyrometer—by G. W. Ducker and E. L. Woodcock, the Perkin-Elmer Corp. for Wright Air Development Center, U. S. Air Force, July, 1957. $1.75; 62 pp. (PB 151031)

A Survey of Adsorption Phenomena in Gas-Solid Phase—by W. M. Herbener, Rome Air Development Center, U. S. Air Force, February, 1958. $.75; 24 pp. (PB 151006)

Methane-Oxygen-Fluorine Flames Spectroscopic and Calorimetric Studies—by J. J. Ball and others, National Bureau of Standards for Wright Air Development Center, U. S. Air Force, October, 1958. $1.75; 69 pp. (PB 151505)

A Review of the Air Force Materials Research And Development Program—Supplement 5—by H. H. Maxwell, Wright Air Development Center, U. S. Air Force, December, 1958. $3.50; 217 pp. (PB 111648S4)

Report of Conference of Effects of Nuclear Radiations on Materials Sponsored by Ordnance Materials Research Office—by L. S. Foster, Watertown Arsenal, U. S. Army, February, 1958. $2.25; 84 pp. (PB 151001)

Standardization of VOR Receiver-Recorder System Response—CAA Development Center, Technical Report No. 274. By H. C. Hurley, T. S. Wonnell, J. A. Beck—CAA. April, 1955. $.75; 20 pp. (PB 151346)

Tests of Threshold Lighting Patterns—CAA Development Center, Technical Report No. 276. By H. J. C. Pearson, CAA. August, 1955. $.50; 5 pp. (PB 151326)

Requirements of Threshold Lights—CAA Development Center, Technical No. 272. By H. J. C. Pearson, CAA. April, 1955. $.50; 7 pp. (PB 151283)

Airport Fire Truck Discharges Carbon Dioxide

Airport fire truck discharges 1,250 lb. per minute of carbon dioxide from directional overhead boom. Ground sweep nozzle and two 100 ft. handlines also are available to extinguish aircraft fires. Fire trucks, suitable for Arctic use, can operate at full efficiency at −70F temperatures. Cardox Division of Chemetron Corp., Chicago, will build 34 fire trucks for the Air Force under $1,298,213 contract.

An achievement in defense electronics

HALF CUBIC INCH 90 DB AMPLIFIERS FEATURE NEW CERAMIC TRANSFORMERS

New 455 kc three-stage amplifiers developed by the U.S. Army Signal Corps utilizing the facilities and competence of General Electric provide as much as 90 db gain with 5 kc bandwidth in a volume of one-half cubic inch. This degree of miniaturization evolved from sustained research and development in solid state filters, delay lines and transformers at the Electronics Laboratory, Electronics Park.

The unique bar-shaped transformers developed for these amplifiers, combined with improvements in existing ferro-electric ceramics, permits the most compact packaging with extreme gain. This achievement in research and development is indicative of General Electric's technical competence in defense electronics.

217-2

Progress Is Our Most Important Product

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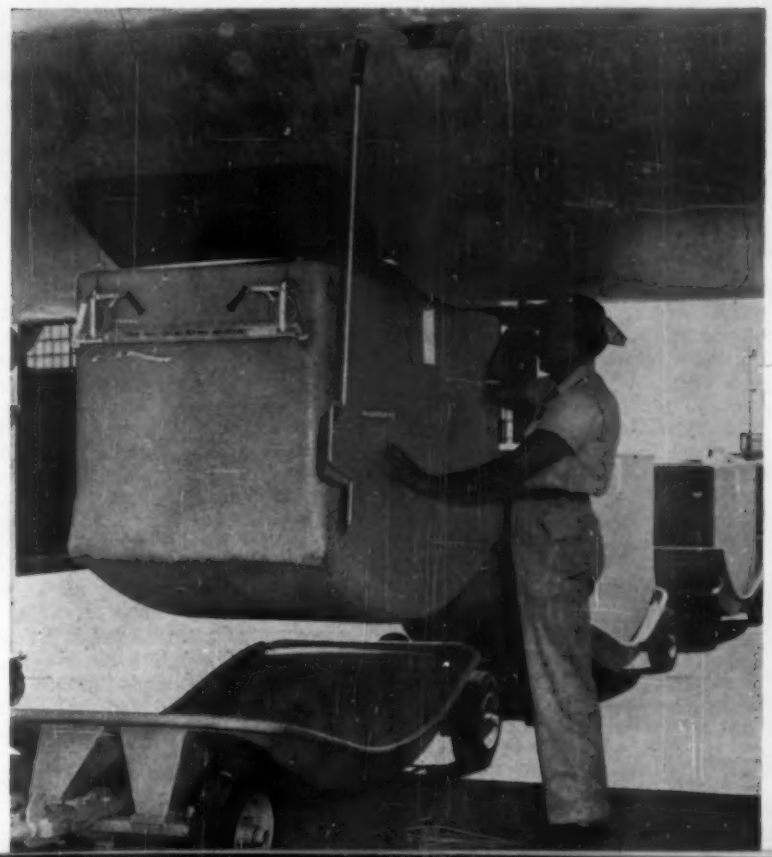
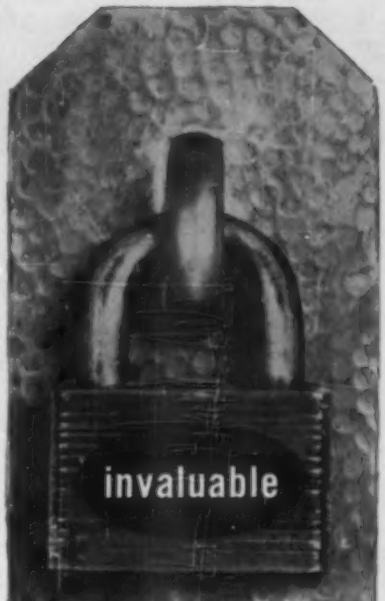
Defense Electronics Division
Heavy Military Electronics Department
Syracuse, New York

United, Douglas Design DC-8 Baggage System

United Air Lines and Douglas Aircraft Co. have devised a new baggage loading system for Douglas DC-8 turbojet transport services, said to make it possible to remove baggage from the aircraft in less than three minutes. Baggage is loaded into glass fiber containers (above); each container contains 25 pieces of luggage or 1,100 lb. of mail or freight. Containers are trucked to the aircraft where they are hoisted into the cargo compartment; ramp serviceman below is operating electric hoist on a DC-8 fuselage mockup by pushing button over his head. Crank is used to propel the container into its proper place. Each aircraft can carry 11 containers with additional space available for bulky cargo.





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SWEPT vertical stabilizer, down-turned wing tips, retracted gear mark design changes in the Cessna 210.

Aviation Week Pilot Report:

Cessna 210 Design Changes Add Speed,

By Richard Sweeney

Wichita, Kan.—Cessna 210, newest entry in the business airplane field, indicated during AVIATION WEEK evaluation here that it meets or exceeds all the specifications set down for the high performance single engine, high wing monoplane with retractable landing gear.

The 210 is intended to fill a gap in Cessna's model line between the fixed landing gear Skylane which sells for $17,095 and the $59,950 twin engine Model 310-C. Projected price for the 210 currently is $22,450 for a standard equipped airplane.

Feature of the airplane is its vertical stabilizer, which is swept 35 deg., adding somewhat to the airplane's directional stability as well as imparting a rakish appearance.

Also immediately noticeable is a change at the wing tips of the 210, which in this case consists of a definite down turn.

In the 210, Cessna is using the same basic landing gear which has been used in earlier airplanes, that is, the single spring steel strut, only in this case it has been arranged for the pinion gear to rotate about the top mounting point, so that the gear swivels up and backward and rotates into a sealed compartment in the fuselage. The nose gear retracts forward, and is fully enclosed while in flight, as are both the main gears. Each of the main gears has its own small sealed compartment.

The airplane has received its Federal Aviation Agency type certification at a gross weight of 2,900 lb. for takeoff. It is powered by a Continental IO-470-E six cylinder horizontally opposed, air cooled direct drive engine with fuel injections, basically the same powerplant which is used in the 310-C. Fuel specification is 100/300 octane, to meet the horsepower rating of 260 at 2,625 rpm.

Family Resemblance

Family resemblance between the 210 and its predecessors in the single engine Cessna line is clearly visible, excluding the swept vertical stabilizer.

A highlight of the airplane is the effect of the fuel injection system in preflight planning and power handling en route. The system makes use of a gage on the pilot's panel which tells fuel pressure at the metering point. The pressure gage in the cockpit is graduated from zero to 20 lb. pressure, and has green band markings which show altitude and per cent of power for the best engine operation. A vernier mixture control enables full advantage to be taken of ambient conditions, and provides flexibility in changing power setting to compensate for unexpected en route weather changes.

In all performance regimes investigated during AVIATION WEEK flight evaluation, at all weights, temperatures were above standard, but the airplane met and exceeded all specifications which are predicated on standard temperature.

The cockpit, instrument panel and controls layout in the 210 are conventional. Pilot's flight gages are on the left of the panel, the radio controls are in the center, while engine gages are on the right but still fully accessible to and easily readable by the pilot. In the lower center section of the main instrument panel are the throttle, propeller and mixture controls, all of which are of the vernier type.

Hydraulic system controls for landing gears and flaps are mounted on a small console which is directly beneath the center section of the main instrument panel, with the landing gear lever on the left and the flap operating lever on the right. Below is the emergency hydraulic pump. A feature of the Cessna hydraulic system is that a reservoir with 125% of the normal fluid capacity is installed immediately behind this control box, allowing for emergency hand pump operation of the landing gear in case of hydraulic failure of the engine-driven hydraulic pump.

With the normal check valve the system provides, it would take a significant leak at one of the actuating cylinders in

UNUSUAL on a high wing monoplane, the retractable landing gear of the Cessna 210 begins takeoff retraction cycle.

Controllability

order to completely lose control of the landing gear in case of emergency.

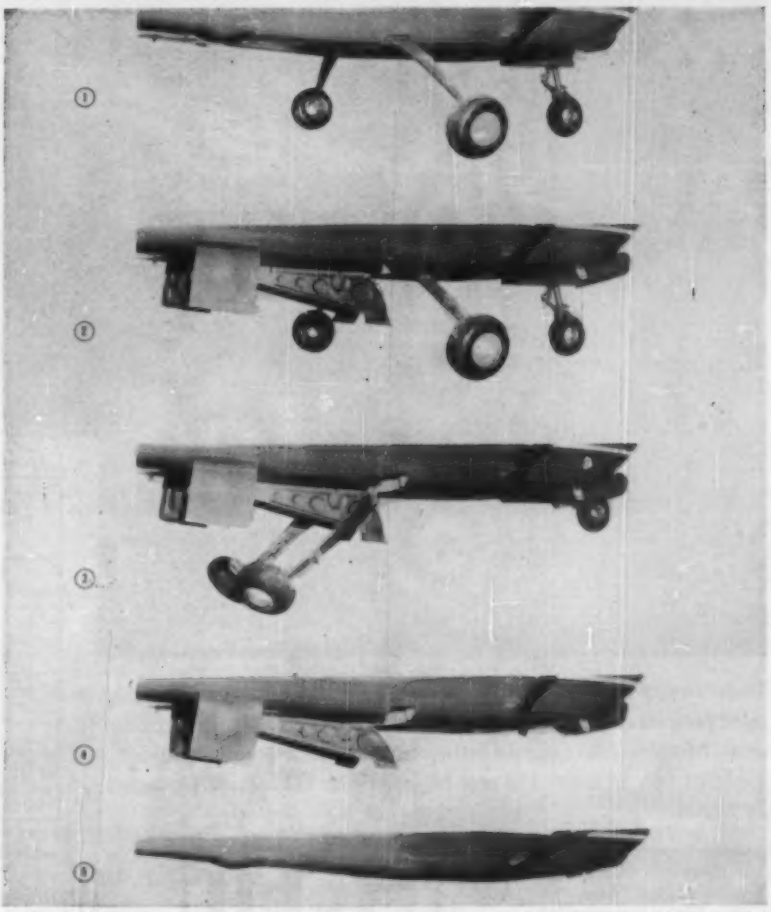
Locking devices for the three landing wheels are of the positive mechanical type. The compartment doors for both main and nose gear are hydraulically locked closed while in flight. The nose and main gear doors are held by hydraulic locks when in a closed position.

In general flight characteristics the airplane is very similar to the other airplanes in the Cessna line. With the new swept vertical tail, the directional stability of the aircraft is extremely good, and a rudder trim tab is provided. In lateral axis, the airplane has very effective ailerons and a very good rate of roll for the type of aircraft.

Longitudinally, the aircraft is very sensitive. Trim-out for straight and level hands-off flight takes some fine adjustment of the elevator tab; however, once it has been accomplished, the aricraft maintains a very good stability in the pitch axis. The airplane has extremely effective elevators and elevator tabs.

The various speeds illustrated by the airplane during the flight evaluation at various altitudes were:

• **In initial climb,** indicated airspeed of 115 mph., a temperature of 16C, using 24 in. manifold pressure and 2,450 rpm. yielded a climb rate of 1,000 fpm. to 8,000 ft. at approximately three-fourths of the normal



MAIN landing gear of the Cessna 210 rotates about top attachment point, swivels up and backward in retraction sequence. Nose gear folds forward into fuselage.

Mobil

FLY WEATHER-WISE

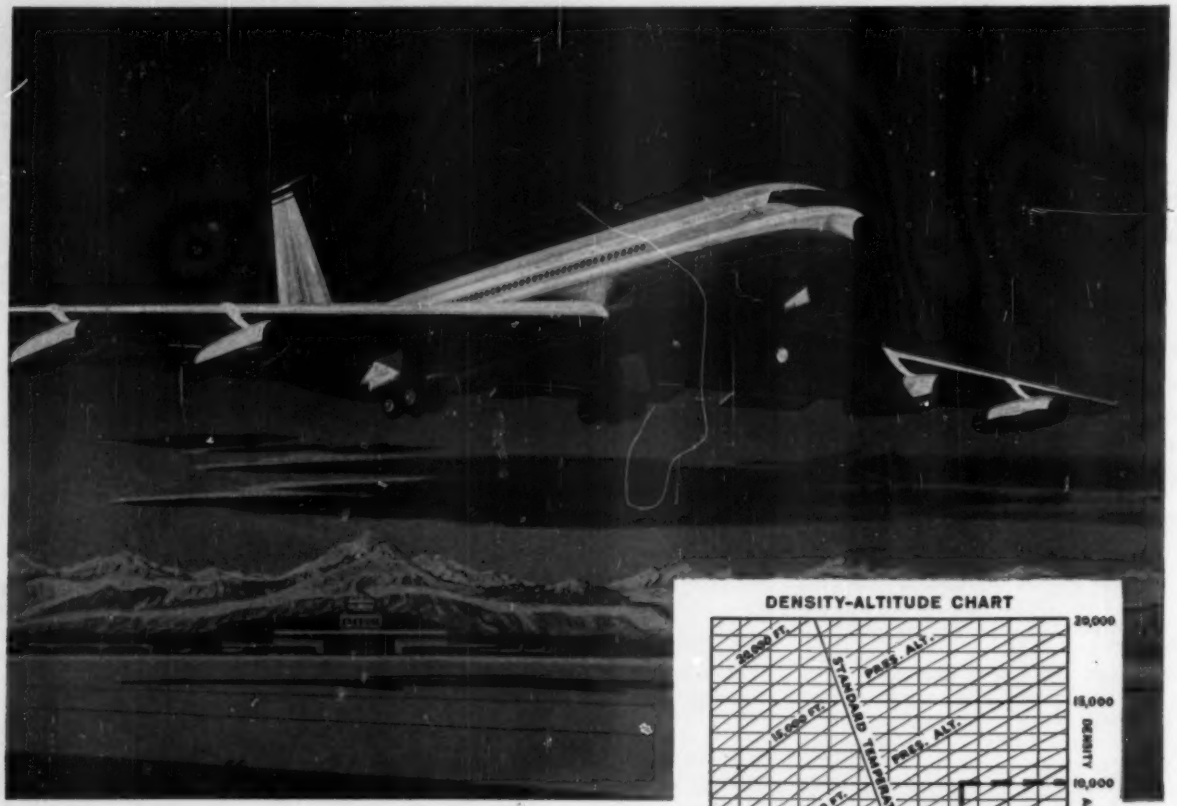
AIR DENSITY

EFFECT ON FLIGHT

These weather items prepared in consultation with the United States Weather Bureau

Air density plays an important part in the take-off and flight performance of today's gas-turbine aircraft. Low densities reduce engine thrust and aerodynamic lift. Since density decreases with altitude, the higher the altitude the longer the take-off run. Therefore the density at airport altitude (Density-Altitude) is an important factor in calculating maximum fuel load and pay load. Barometric pressure and ground air temperature affect density. As both are continually changing, the Density-Altitude of the airport continually changes—may vary as much as several thousand feet a day.

Density-Altitude can be determined by knowing barometric pressure (at airport, not sea level) and temperature. Charts similar to the one below can be used.



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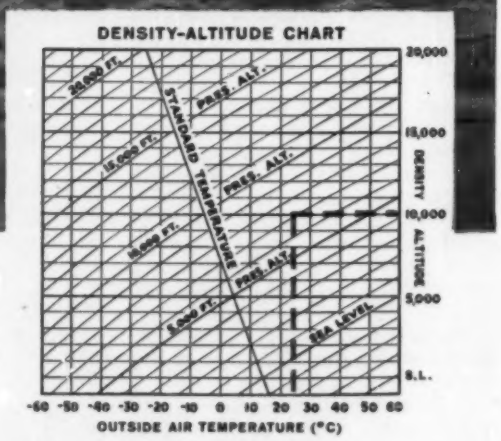
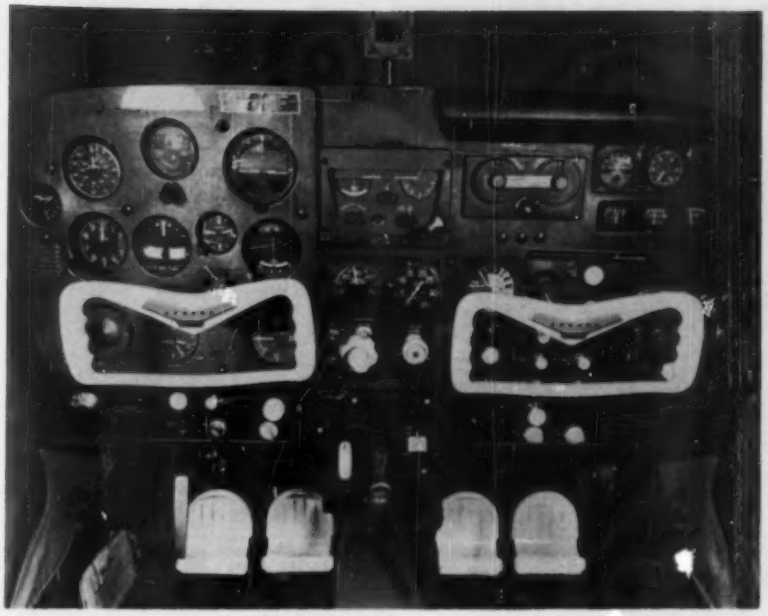


Charts like this are useful in determining Density-Altitude. The Pressure-Altitude (reading when altimeter is set at 29.92) and the Temperature at the airport are entered to find Density-Altitude.



INSTRUMENT panel for the 210 has flight instruments on the left, engine instruments and radio-navigation instruments at center. Gear handle is on center, lower console.

gross weight of the aircraft. True airspeed in this condition was approximately 126 mph.

• **After 8,000 ft.,** using 20 in. MP, and 2,450 rpm., rate of climb was 800 fpm., IAS of 112 mph., TAS of 130 mph.

• **At 10,000 ft.,** the aircraft indicated 155 mph., using 20 in. MP and 2,450 rpm., which is approximately 62% power, yielding a true airspeed of 185 mph. In this situation, 6.4 psi. fuel pressure was used, which would result in a normal fuel consumption of 11 gph.

• **High altitude climb,** at 12,000 ft., used a 74 mph. IAS for best angle, which gave a 650 fpm. climb rate, with the engine running at 17.5 in. MP, 2,600 rpm. (approximately 70% power) at 7C temperature, showing a true airspeed of 91.5 mph. at 14,800 ft. Still at best angle of climb speed of 74 mph. IAS, the aircraft was registering a 600 fpm. climb rate at 65% power, 16 in. MP and 2,600 rpm., with a true airspeed of 92 mph.

• **At 16,000 ft.,** after conditions were stabilized initially at 16.25 in. MP, 2,600 rpm., at a temperature of 1C, the aircraft indicated 139 mph. for a TAS of 183 mph.

• **Following a period** of time at the same power setting and altitude, the indicated airspeed advanced to 144 mph., at 16,000 ft., yielding a true airspeed of 189.5 mph.

• **At low cruise altitude,** 2,500 ft., using a power setting of 26.5 in. MP, 2,600 rpm. (84% power) the aircraft indicated 180 mph. This trued out, at ambient temperature, at 195 mph. TAS.

INTERIOR trim for rear passenger seats and accessibility to the compartment is indicated in this view.

Flight Characteristics

The 210's flight characteristics at both low altitude and medium altitude (up to 15,000 ft.) are highly similar, if not identical.

The airplane's qualities change very slightly, if at all, throughout the speed and altitude spectrum.

The airplane is stable about all axes. However, due to very effective elevator trim tabs, the aircraft is sensitive in trimming out for straight and level flight. Effectiveness of the elevators also affects the longitudinal sensitivity of the aircraft. Once the airplane is trimmed properly in the longitudinal axis, it re-

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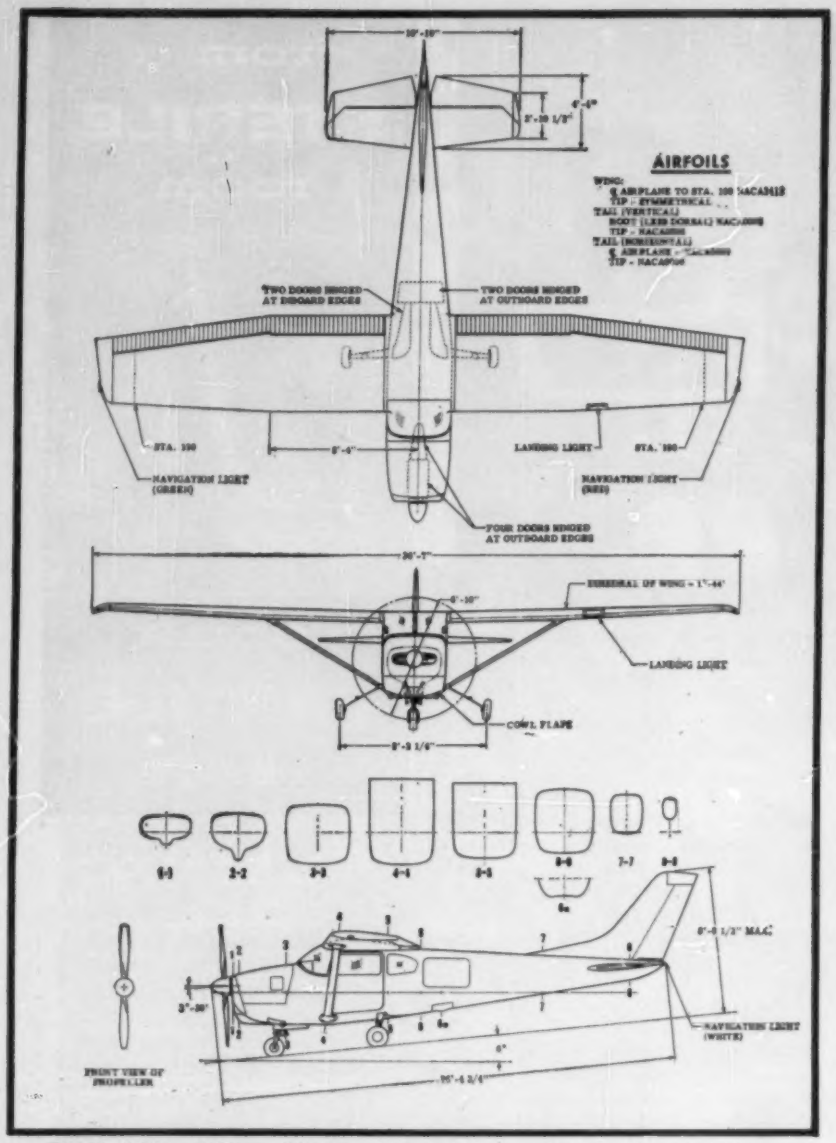
REPRESENTATIVES

West Coast: William E. Davis, Box 642, Inglewood, California
Denver: Price Engineering Sales Assoc., Box 421, Littleton, Colo.



THREE VIEW of Cessna 210 shows layout of the new business plane, including swept vertical stabilizer and retractable landing gear.

mains stable and is not subject to wandering in this axis.

The airplane showed good natural damping characteristics on induced longitudinal oscillations. Starting at 8,000 ft., approximately one-half available up-elevator displacement was used, controls released and the aircraft allowed to damp out the longitudinal cycles. The nose was pulled up approximately 20 deg. above the horizon when the controls were released. The aircraft returned to the cruise altitude after four and one-half oscillations. Maximum vertical travel from peak to valley was 420 ft. at the first oscillation, damping to approximately 30 ft. in the last complete oscillation before a return to trim at level flight.

In the lateral axis, almost full wing-down aileron to the left was applied with the aircraft trimmed in straight and level cruise conditions. Rudder pedals were not used, and only a slight degree of longitudinal control was retained, otherwise the aircraft was allowed to follow its natural tendencies. In the lateral displacement, the aircraft went through three and one-half cycles before returning to straight and level flight in the trimmed condition.

Directional Stability

In a check of directional stability characteristics, the aircraft again starting from a trimmed straight and level cruise condition, indicating that the airplane's swept fin and rudder are very effective. A full displacement of the rudder was made to the left, the aircraft followed approximately three-quarters of the cycle before returning to straight flight; that is, after the pedal pressure was released, the aircraft swung back about half way past neutral to the other extreme, then returned to center, trimmed condition.

Also investigated was the aircraft's spiral stability, i.e., its stability to return to straight and level flight following the initiation of the descending spiral. For this, the aircraft was trimmed into a normal 500 fpm. rate of descent with proper power setting. Aircraft returned to straight descent quickly, indicating no tendency to "tighten up," and rather immediately initiated its recovery.

One of the features to which Cessna's engineers attribute the spiral stability of the Model 210 is the downward turn used on the wing tips.

In all cases, the airplane can be trimmed to a good hands-off flight condition. However, longitudinal trim for the primary flight path, that is climb, descent or straight, sufficed to hold the aircraft to the desired track and altitude, and no excessive back pressures or forward pressures were required to compensate for changes in direction during turns in climb or dive.

Rudder Turns

With its extremely effective vertical stabilizer and rudder, the 210 can be turned using rudder only, although the maneuver is sloppy.

Primarily, the rudder requires very light pressures and in no case does it become excessive in normal turns and similar maneuvers.

Turns were made both single and double needle width, as well as steep turns at bank angles up to 60 deg. and slightly beyond.

Best angle of climb speed for the 210 is 74 mph. IAS. Climb at this speed was made from approximately 2,000 ft. to better than 8,000 ft., some of it through turbulence due to the proximity of summer thunderstorms. When these were encountered, the aircraft, well trimmed out for the climb, seem to coast over the updrafts and suffer no major displacements from its prescribed flight track. Holding the indicated airspeed, the aircraft was still climbing at a rate of 650 fpm. at 12,000 ft. using 70% power with a ¾ total fuel load and two persons aboard.

Using the best rate of climb speed, 104 mph. IAS, at 1,000 fpm. from takeoff at maximum gross weight, the aircraft still registered 900 fpm. climb rate at 5,000 ft., and very little degradation occurred until considerably higher altitudes were reached.

Accelerated maneuvers in the airplane such as high speed turns, steep turns

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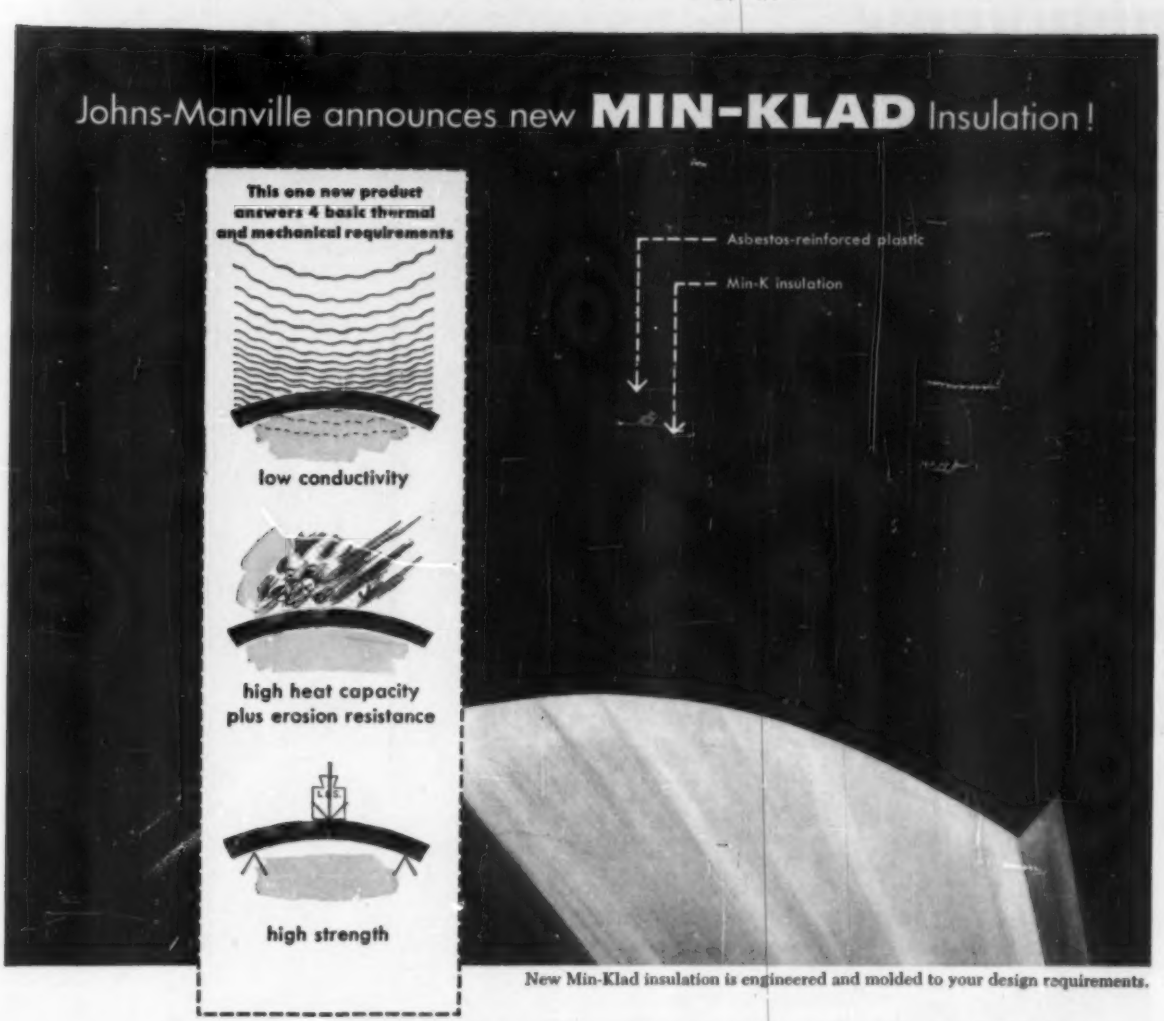
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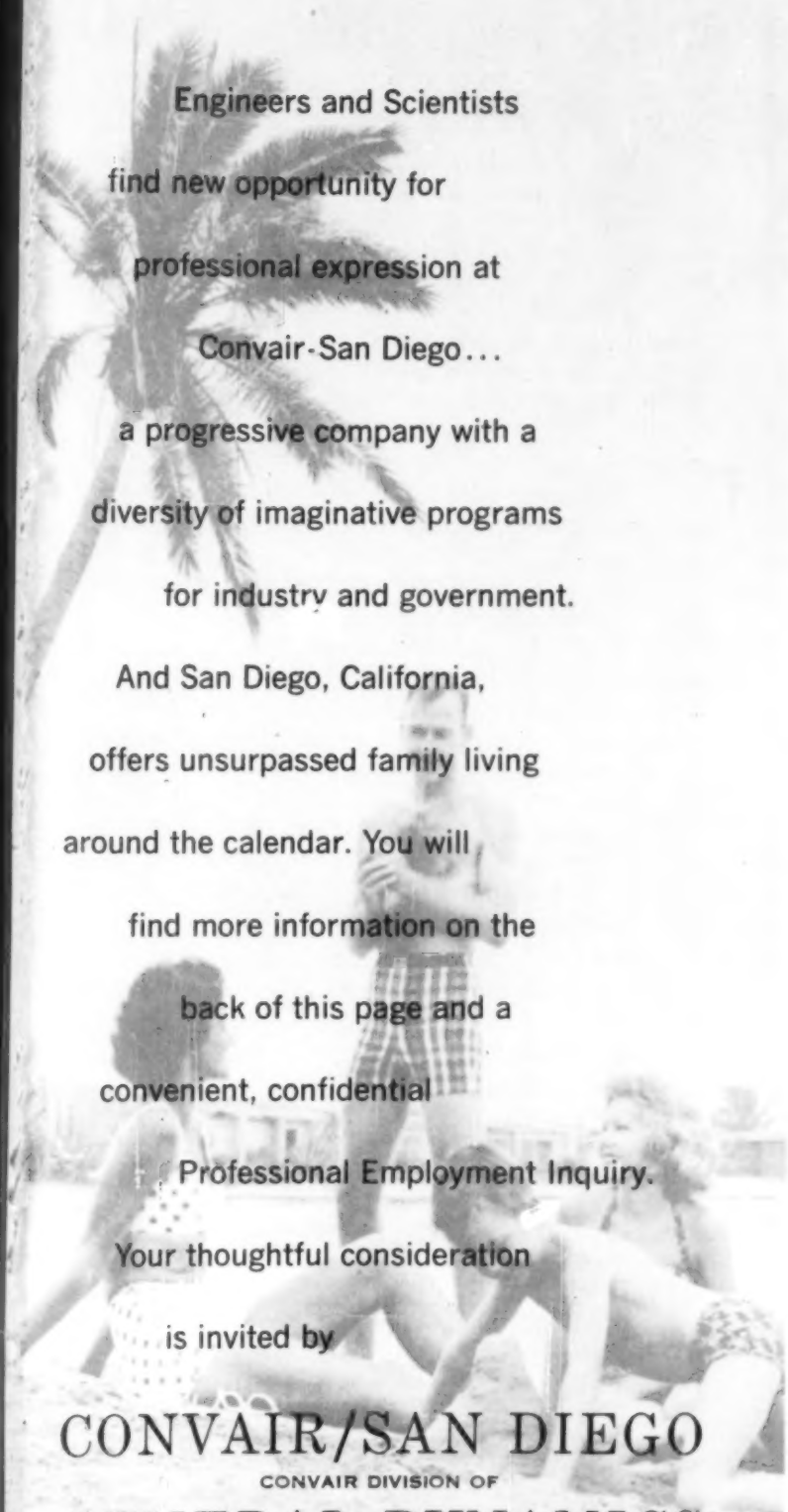

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and sharp pullups, produced buffet under certain conditions but with no tendency for the aircraft to snap in either direction. The high speed steep turn at altitude, at an average cruise gross weight, resulted in the aircraft running out of elevator travel, before the effects of the acceleration were felt. In this, the aircraft was sucked into the turn until full elevator displacement had been obtained; as the aircraft slowed down, an altitude loss of 500 fpm. was established as the steady state result, using cruise power. At no time throughout this turn did the aircraft have a tendency to buffet or to snap, and full control displacements were made as smoothly as possible.

The same characteristics held true when pulling the aircraft into a tight turn with power off, both left and right, in that the plane ran out of elevator, but in this condition an aerodynamic buffeting does occur due to the acceleration. The aircraft, however, will not reach a complete stall. During the entire maneuver full control is available in both lateral and longitudinal axis.

In stalls performed straightaway, in landing configuration, at 14,500 ft., the aircraft started to shudder at 40 mph. IAS, after which it started to fall through, but did not do a complete break. The aircraft had no inclination to drop a wing, nor did it exhibit any unusual tendencies.

Throughout the entire stall regime, power-on and power-off, at high and medium weights, high and low altitude, the aircraft's primary tendency was to run out of elevator. Starting from a low speed trim condition, aerodynamic buffeting was felt, and a slight pitch-up, after which the nose would fall through. With full back elevator held after the break, the airplane would then start to re-enter the buffet region and stall condition, resulting in a pitching up and down as the aircraft lost altitude at approximately 1,000 fpm. rate.

LANDING GEAR retracts in 3 to 5 sec. from time handle is moved until gear doors close.

TURNED-DOWN wing tips of the Cessna 210, visible in photos above, aid spiral stability.

210 Engine

Continental IO-470-E	Spec. 1547b
Rated horsepower	260
Rated speed (rpm.)	2,625
Cruising speed (economy rpm.)	2,200
Cruising speed (performance rpm.)	2,450
Bore (inches)	5.000
Stroke (inches)	4.000
Displacement (cubic inches)	471
Compression ratio	8.6:1
Dry weight	428
Fuel (aviation grade octane)	100/130
Engine Accessories	
Carburetion	Fuel injection
Generator	35 amp. - 12 v.
Starter	12 v.
Magnetos	(Scintilla) S6RN-25 each Mag. times 24 deg. before TC
All weather harness	
Spark plugs	Champion REB-37N
Tachometer	Mechanical drive, SAE Type 1
Oil sump (qt.)	12
Oil pressure (psi.)	30-60
Oil temperature	75F for takeoff 225F maximum
Cylinder temperature (bayonet thermocouple)	460F
Oil grades	SAE 50 above 40F; SAE 30 below 40F

High-Weight Stalls

Stalls performed in the aircraft at 7,000 ft. immediately after takeoff, that is at highest possible gross weight conditions, in all configurations, showed the aircraft to have the same high stability as in other flight regimes. With power on, gear and flap down, the aircraft has a slight tendency to pitch up as the stall is reached, the nose falls, then will rise and drop and rise and drop again, with an average descent rate of 1,000 fpm. This condition is for the full elevator deflection retained, without recovery. With the flaps up, the gear down and power off, the aircraft had a tendency to fall off on one wing.

In all stall conditions investigated, the high pitched stall warning horn is heard approximately 8 mph. above the stall.

Throughout all stall conditions, full lateral and directional control is easily maintained with minimum deflections of control surfaces. In a turning stall, the aircraft falls off to the inside, and will descend into a spiral, with airspeed registering less than 40 mph. IAS. However, upon release of the controls to neutral, the aircraft rights itself directionally and will return to straight and level flight conditions for which it was trimmed originally.

Specifications indicate a stall of 59 mph. with full flaps and landing gear extended. However, it was noticed that at this indicated airspeed the aircraft assumes a slight negative rate of climb, (less than 100 fpm.) without entering a severe buffet which denotes a stall and must continue to be worked on to the stall break, which occurs at approximately 38 mph. IAS, at which the aircraft assumes a descent rate of 500 fpm.

In all stall investigations, release of the controls after the stall results in the aircraft assuming a nose-down attitude, regaining speed, and a return to the original flight path for which it was trimmed.

Use of the FAA-recommended standard stall recovery technique, that is, nose to the horizon and power applied, results in the airplane flying out of the stall very swiftly and efficiently.

When control back pressure was released, allowing the aircraft to fall through without applying power, the airplane quickly regained speed and returned to level flight.

In the turning condition, both left and right, the aircraft can be pulled

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210 Performance

Gross weight	2,900 lb.
Speed: best power mixture	
Maximum at sea level	199 mph.
Maximum recommended cruise,	
75% power at 7,000 ft.	190 mph.
70% power at 8,000 ft.	187 mph.
Range: normal lean mixture	
Maximum recommended cruise,	
75% power at 7,000 ft.	755 mi.
55 gal., no reserve	4.0 hr.
	188 mph.
70% power at 8,000 ft.	780 mi.
	4.2 hr.
	186 mph.
Maximum range mixture:	
Maximum range at 10,000 ft.	1,100 mi.
55 gal. no reserve	8.0 hr.
	137 mph.
Rate of climb at sea level	1,300 fpm.
Stall speed (flaps and gear down)	59 mph.
Service ceiling	20,700 ft.
Absolute ceiling	22,400 ft.
Takeoff:	
Ground distance	740 ft.
Total distance over 50-ft obstacle	1,135 ft.
Landing:	
Ground distance	520 ft.
Total distance over 50-ft. obstacle	1,190 ft.
Empty weight	1,760 lb.
Wing loading	16.5 lb. psf.
Power loading	11.2 lb./hp.
Fuel capacity	65 gal.
Oil capacity	12 qt.

Powerplant—Continental IO-470-E engine, 260 rated hp. at 2,625 rpm. Wing span—36.5 ft. Wing area—175.5 sq. ft. Length—26.4 ft. Height—8.15 ft. Tread—8.2 ft. Baggage—120 lb.

back and reefed in until full elevator displacement is obtained, without reaching a buffet or a break point in stall.

Takeoff and landing techniques in the 210 are perfectly straightforward. The aircraft incorporates the same type of flaps as previous Cessna high wing airplanes, resulting in the same high efficiency in both landing and takeoff applications.

Only possible problem area is the long (6 in.) travel of the nose gear shock strut. To effect a landing on the main wheels first, a more severe nose-high attitude is required than is usual in tricycle gear aircraft. In fact, it approaches the same attitude used in the old style stall-out three-point landing.

However, there is no real problem with over-the-nose visibility, and should the nose wheel touch down in nose-high attitude, in effect making a three-point landing, no ill effects are suffered since the strut has such a long travel.

First takeoff in the aircraft indicated that the airplane is very light on the controls. It flew off smoothly with ordinary back pressure. Initial takeoff was at an ambient temperature of 20C. Climb-out was done at 115 mph. indicated airspeed, at 24 in. manifold pressure, 2,400 rpm. Aircraft sustained 1,000 fpm. rate of climb. Aboard were two persons and a normal fuel load, leaving the airplane at somewhat less than maximum takeoff gross weight. Landing gear retraction time ranges from 3 to 5 sec. from the time the operating handle is moved to closing of the doors at the wheels-up condition.

No severe trim changes were noted during or after the retraction cycle; that is, while the doors were opening or closing or in the open position prior to closing either on extension or retraction of the gear.

Landing Characteristics

Among the conditions and configurations investigated in the landing characteristics of the 210, one was a power-off descent starting at 9,500 ft., approximately 3 mi. west of the airport at Newton, Kan. For this investigation the throttle was completely retarded, full flaps and landing gear were lowered, and full elevator tab travel was used. This resulted in a rate of descent of about 1,200 fpm., and throughout descent the aircraft proved extremely stable and controllable. In this condition and configuration the airplane was flown back and forth, simulating impossible difficulties in reaching an airport in emergency condition. Airspeed was held at 80 mph., including coming over the fence, and the airplane showed very good characteristics and qualities throughout. Turns during the descent were one needle width, two needle width, and steep turns, with bank angles ranging up to 60 deg.

In a no-flap landing, at a reasonable gross weight (with more than half fuel still aboard), the aircraft retained its good landing characteristics. However, in this configuration the aircraft will have a tendency to float down the runway. In addition, full elevator travel is used to get the nose high enough to avoid letting the nose gear touch down first. Even using this technique, the aircraft landed in a virtual three-point position, indicating that it is a completely acceptable technique for landing.

Landing Technique

Standard landing technique calls for using flaps as required, bringing the aircraft over the boundary at 85 or at the most 90 mph.

One ILS approach was made with the aircraft at lighter than normal gross weight, and during the travel down the glide slope, with a cross-wind and gusts, the aircraft proved very stable. Normal approach speed for an ILS would be in the order of 110 to 120 mph., although the aircraft can be flown at speeds all the way up to 160 mph.—which is the maximum for the gear—and 10 deg. of flap speed.

Majority of the landing and takeoff work was done at higher than normal ambient temperatures both on the ground and in the air, as well as a relatively high humidity percentage. Temperatures ranged up to 30C, while humidity ran as high as 90 to almost 100%, due to area thunderstorms.

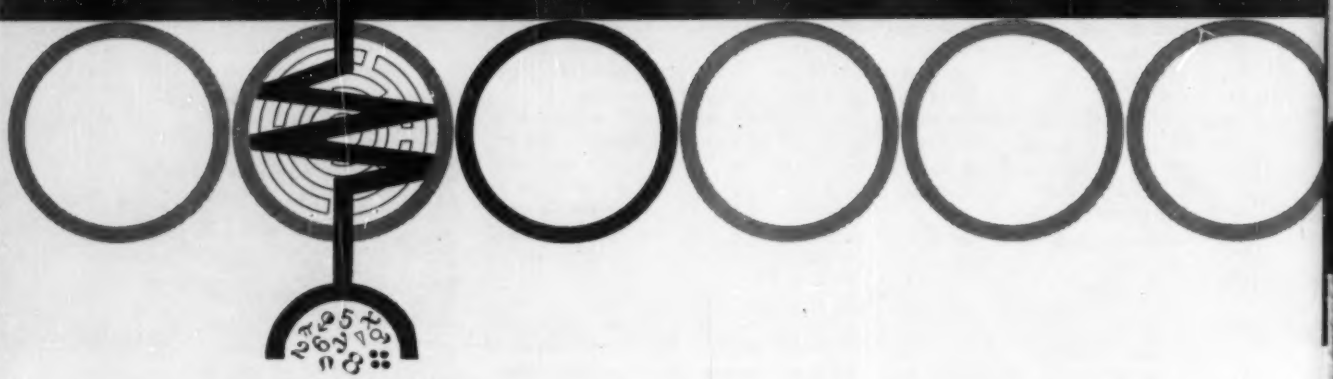
Normal takeoff flap angle is 10 deg. However, one takeoff was made from Wichita Municipal Airport using 20 deg. of flap, lifting the aircraft off the ground at 70 mph. indicated airspeed.

Maximum gross weight takeoff was made at 32C temperature, 1,500 ft. mean sea level airport altitude, 20 deg. of flap, 30.00 in. altimeter setting. The aircraft was flown off at 60 mph. IAS, at which value the feel was solid, not as if the airplane were struggling to get off. After unstick, the airplane was accelerated to approximately 65 mph. for initial climb.

Another takeoff was accomplished under the same conditions with the aircraft at approximately 2,750 lb. gross weight, some 150 lb. of fuel having been burned out, but no flaps were used. The aircraft became airborne after 12 sec. run, covering about 700

TURNED-DOWN wing tip is shown in closeup above.

BAGGAGE COMPARTMENT behind cockpit holds 120 lb. maximum.



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180	33	
182	74	
310B, C	23	
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Colonial C-2 Skimmer IV	N.A.	N.A.
Helio H-391B Courier	2	$62,000
H-396 Super-Courier	—	
Mooney Mk. 20	18	$207,000
Piper Super Cub	45	$3,500,000[1]
Tri Pacer	64	
Apache	33	
Comanche	112	
Totals	723	$11,966,000[1]

[1] Estimate.
N.A.—Not available.

ft. to point of liftoff. Here again, the aircraft exhibited good characteristics and came unstuck with ordinary back pressure.

Several different landing patterns were flown in the airplane, including the 360-deg. overhead. On the 360-deg. overhead, airplane configuration varied from full flaps and landing gear with power chopped at the initial break point 1,000 ft. above the runway threshold, to a power chop with no flaps, and the gear not extended until very late on final approach.

For this, the airplane was flown over the runway threshold on final at 200 ft. above the surface, 100 mph. indicated airspeed. The aircraft proved to be fully able to effect a landing, settled approximately on the ground at midfield of a 4,000 ft. runway, and was allowed to roll out without using brakes, which was completed by approximately ¾ point.

Another investigation started with the aircraft established at a speed of 95 mph. IAS, 10 deg. flap and landing gear down on the down-wind leg, 20 deg. of flap being lowered after turn off the base leg, speed of 90 mph. and 30 deg. of flap on final approach, and full landing flap at 500 ft. above the runway threshold. The aircraft was brought over the fence at 500 ft. altitude, 75 mph. indicated airspeed and power was chopped.

From this entry, the aircraft effected a landing in minimum distance, simulation of a high power approach over obstacles to a short field landing.

One ILS approach was run at 130 mph., with gear and 10 deg. flap extended. The airplane retained very good characteristics for stability and controllability. The approach was broken off at the threshold, the aircraft was placed into cruise configuration and cruise power was applied, and at the far end of the runway speed was traded for altitude.

The airplane gained approximately 1,000 ft. without airspeed dropping below 100 mph. indicated.

Instrument panel layout in the Cessna 210 is conventional. The pilot's flight instruments are on the left, with two radios in the top center portion of the panel. Underneath the radio controls are the three primary engine gages: manifold pressure, tachometer, and fuel pressure gage for the fuel injection system. The engine temperature gages and fuel quantity gages for the two wing tanks are mounted at the upper right corner of the panel, underneath the ammeter and vacuum gages.

The bottom of the pilot's panel has a small ADF mounted on the left, with the engine operating switches and cabin environment control immediately adjacent on the right. Included in the engine operating switches are the starter button, magneto and battery master switch. On the right side of the panel,

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under the copilot's control wheel, are various electrical system operating switches, the engine cowl flap control (which is a closed, half-open and whole-open three-position lever), while on the right are the various circuit breakers for the aircraft systems.

Trim tab control wheels for pitch and yaw trim are located on the center tunnel between pilot and copilot seats. No roll trim is provided. Rudder trim is accomplished without rudder trim tabs. Spring tension in the rudder system displaces the entire rudder to achieve the desired trim.

Structurally, the 210 is similar to previous Cessnas. Wings are of two-spar metal construction. To clean up the airplane the wing struts are faired into the wing and fuselage, and tie-down fittings retract into the strut. Flaps are the basic type used on earlier airplanes, the 172 and 182.

The fuselage is structurally similar to earlier aircraft, being of built-up sheet metal construction.

The elevator and rudder on the 210 incorporate smooth skins, while flaps and ailerons use the same corrugated metal which has been standard on earlier Cessna airplanes.

The use of hydraulic systems for its commercial airplanes is new to Cessna. In Cessna's earlier single-engine fixed gear aircraft, flap operation was manual, while in the 310, gear and flap operation is electromechanical.

The hydraulic system uses petroleum base aircraft hydraulic oil (per Spec. Mil-H-5606). System is designed to operate from −40F to +160F. Materials are in compliance with CAR Part 3 and Mil-H-5440 requirements in regard to strength, corrosion protection, finishes, packings and filtration.

The hydraulic pump, which is driven from the right rear accessory pad of the engine, is a constant-delivery type rated at 0.38 gpm. at 1,500 rpm. and 1,500 psig. The pump rotates at 150% of engine rpm.

The nose gear retracts forward and up, rotating about an axis through its trunnion and near the lower firewall. Movement is by a double-acting cylindrical actuator which also serves as the drag strut. It is provided with automatic down-lock and limit switch. An uplock latch is provided to engage the nose gear wheel fork in the retracted position, and is spring-loaded to lock and release hydraulically by a lock actuator. The up-lock hook mounts the limit switch, which indicates when the up-lock hook will engage the nose gear. This limit switch, together with the two main gear switches, indicates the gear's location by either a red (up) or green (down and locked) light on the gear operating console.

The main gear rotates about a skewed axis beneath the floor at the upper inboard of the main gear strut, with the gear struts rotating aft and inboard to stow the wheels in the aft-lower fuselage section. The struts are maintained in the down position by spring loaded locks, released hydraulically by a lock actuator prior to gear extension. Actuation of the main gear is by a conventional cylindrical actuator with a rack and pinion to deliver rotary motion.

The rack and pinion gear is sealed in the main gear actuating cylinder.

The forward nose gear doors open for nose gear retraction or extension and return to closed position at the completion of a cycle. Main wheel-well doors also close at the completion of either cycle. The forward nose gear doors are held in closed position by spring load latches, released hydraulically prior to opening by the same lock actuator that releases the nose gear uplock.

Currently, the 210 carries 65 gal. of fuel in two tanks—one in each wing. On the prototype airplane flown, N1296, usable fuel was rated at 55 gal. However, the company indicates that this is going to be changed in the near future, with installation of a new-type sump fuel pickup, so that usable fuel will increase closer to the total gallonage carried.

Also, the 210 will be equipped with an optional auxiliary fuel tank system, but how much will be incorporated, and its location, remain to be seen.

The engine is mounted on a conventional tubular frame. Engine controls are vernier type for throttle and propeller as well as mixture, allowing for greater flexibility and finer control.

The engine cowling is in two main proportions: a fixed lower cowl, and an upper cowl in two sections, hinged down the middle. The upper halves will open about the centerline, for engine maintenance. The lower cowl is fixed, providing a rigid nose section for the nose wheel retraction mechanism, gear doors, wheel wells and nose cap structure and cowl flap attachments. It runs from the wheel well up around each side of the nose to a line 6 in. below the exhaust outlets.

Aerojet-General Model 15NS-250 JATO rocket engines are mounted in holders incorporated in the rear fairing of each nacelle.

Beechcraft Twin Bonanza Gets JATO Rocket Assist

JATO installation on the Beechcraft Model 50 Twin Bonanza, recently approved by FAA, is reported to add a total of 200 hp. to the executive twin for making short field takeoffs or emergency climb maneuvers. Installation is similar to that offered on Beech Super 18 (AW Feb. 16, p. 129). Aerojet-General solid fuel Model 15NS-250 rocket engines each develop 250 lb. thrust for a duration of 15 sec. Rate of climb for Model G50 Twin Bonanza at 7,150 lb. gross weight is said to be boosted 550 fpm. on takeoff (minimum single engine control speed) and 1,190 fpm. at 65% cruise power. Standard model D50B rate of climb is increased by 620 fpm. and 1,375 fpm., respectively, at 6,300 lb. gross weight.

JATO firing switch is located at extreme right of throttle quadrant within reach of both pilot and copilot.

Solid fuel "Junior JATO" rockets develop 250 lb. thrust. Solid propellant accounts for about half of each engine's 24-lb. weight. Standby carriage life of each engine is 500 hr. or one year, whichever occurs first.

Republic F-105—One Depends Upon

New Wings for the Eagle!

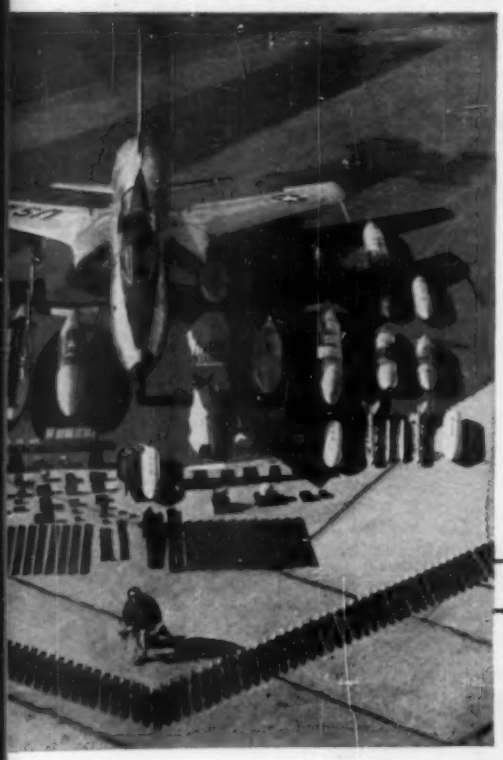
World War II's famed Eagle Squadron, now the 335th Squadron of TAC's Fourth Fighter Wing will soon be flying the F-105 fighter-bomber.

Plane "Bomber Formation" Holley for Fuel Control

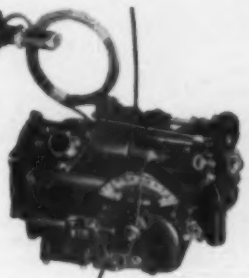
World's most powerful one man airplane, is reported to carry "as much destructive power as an entire big bomber formation of World War II." Capable of carrying an atomic bomb, the exciting Republic "Thunderchief" gets more than 25,000 pounds of thrust from its Pratt & Whitney Aircraft J75 jet engine with afterburner.

Holley designed, engineered and manufactures the main fuel control, bleed governor and actuator for the J75 engine which has both military and commercial applications. The Holley R-95 control combines "small package" design with light weight and exceptional performance reliability. It's another important reason why more and more engine and air frame manufacturers are turning to Holley for engine components.

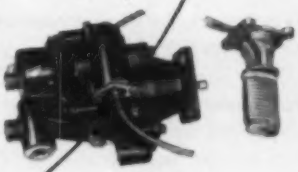
This impressive array of fire power shows why the Republic F-105 supersonic jet is often billed as the "one man airforce."

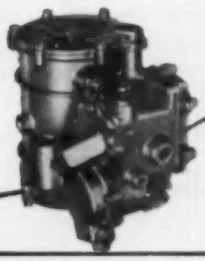


The R-95 is the military version of Holley designed and engineered fuel controls made for the J75 jet engine.



Both the Holley R-98 compressor bleed governor and its companion, the bleed valve actuator (below), are designed and manufactured for the J75 engines.





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WHO'S WHERE

(*Continued from page 23*)

Changes

Charles C. Botkin, manager of the newly established Missiles, Arming and Fuzing Program Office, Missile and Space Vehicle Department, General Electric Co., Philadelphia, Pa. **Robert J. Kirby** succeeds Mr. Botkin as manager of the nuclear ordnance projects operation in the Missile and Space Vehicle Department.

J. C. Roberts, director-facilities construction, Properties and Facilities Department, American Airlines, Inc. Other appointments in the Department: **Robert Kerr, Jr.,** director-special facilities projects and administration; **Reginald J. Sutherland,** director-facilities engineering.

Robert L. Ruth, chief engineer, Marine and Ordnance Department, Vickers, Inc., Detroit, Mich.

Dr. Alex E. S. Green, chief of physics, Convair (San Diego) Division of General Dynamics Corp., San Diego, Calif.

Carroll Stoecker, assistant manager, Aero Engineering Division of The Garrett Corp., Mineola, N. Y.

Perry V. Ogden, manager of materiel, Summers Gyroscope Co., Santa Monica, Calif.

The Government Equipment Division of the Raytheon Co., Watertown, Mass., has established five new units and announced the following appointments: **Glenn R. Lord,** manager, Airborne Electronic Equipment Subdivision, Sudbury, Mass.; **Fritz A. Gross,** manager, Heavy Electronic Equipment Subdivision, Wayland, Mass.; **Gordon S. Humphrey, manager,** Santa Barbara Subdivision (electronic warfare center), Santa Barbara, Calif.; **W. Rogers Hamel, manager,** Submarine Signal Subdivision, Portsmouth, R. I.; **Harold M. Hart,** manager, Systems Management Subdivision, West Newton, Mass.

Carra L. Lane, manager of plant operations, Chicago Pneumatic Tool Co., New York, N. Y., in charge of all manufacturing and engineering operations in the company's domestic plants.

James F. Coleman, manager, Instruments Division of The W. L. Maxson Corp., New York, N. Y.

Jack M. Beauchamp, director, Customer Relations Division, Aerojet-General Corp., Azusa, Calif. Mr. Beauchamp continues as director of technical services. Also: **August F. Bruns,** customer relations manager for Aerojet's Atlantic Division, Frederick, Md.

William Erdman, manager of subcontracts, Chicago Aerial Industries, Inc., Melrose Park, Ill.

Robert W. Deichert, engineering manager-scientific instruments, Industrial Electronics Division, Allen B. Du Mont Laboratories, Inc., Clifton, N. J. **Richard T. Petruzelli** succeeds Mr. Deichert as manager of the Data and Display Laboratory.

Loren K. Hutchinson, works manager, Wyman-Gordon Co.'s Worcester, Mass., plant.

James E. Pitman, manager of product planning for point-to-point communication equipment, General Electric Co.'s Communication Products Department, Lynchburg, Va.

CAB Accident Investigation Report:

CAB Blames Instructor; Hector Dissents

A Capital Airlines DC-3 crashed and burned near Martinsburg Airport, Martinsburg, W. Va., at 1358 on June 4, 1958, injuring the three occupants—an instructor and two pilot-trainees. One trainee, who was flying the aircraft at the time of the accident, died the following day of severe burns. The aircraft was on a training flight from Washington National Airport and was practicing takeoffs and landings at Martinsburg Airport. During the pilot's attempt to climb out after abandoning a single-engine approach to runway 8, the aircraft stalled and crashed in a wooded area.

The Board's investigation indicates that the aircraft crashed because of a stall which occurred at an altitude too low to effect recovery. The stall was caused by poor technique of the trainee-pilot and the failure of the captain-instructor to monitor properly the simulated single-engine approach and balked landing. As a result of this accident, Capital Airlines has implemented staffing and procedural flight training changes. A senior instructor in DC-3s has been given the responsibility of conducting and supervising all flight training for initial upgrading. The flying procedure for all single-engine approaches has been changed requiring the approach to be either completed to a full stop or abandoned above 200 ft. in altitude.

INVESTIGATION

Capital Airlines training flight V-3, a DC-3, N 49553, was released by Capital Flight Dispatch at Washington National Airport to operate VFR in the Martinsburg, W. Va., area for 4½ hr. of training. The crew consisted of Instructor-Pilot Capt. James B. Kinne, and Pilot-Trainees Leighton R. Tomkins and Edwin A. Henderson. The aircraft departed Washington National Airport at 1110[1] with 820 gal. of fuel aboard (full tanks) and 500 lb. of ballast properly strapped to the floor in the rear cargo compartment. The weight of the aircraft at takeoff was 23,905 lb., which was well within the maximum allowable gross weight of 25,346 lb.; the load was distributed so that the center of gravity was within prescribed limits.

The flight was the second of a 12-hr. instruction course that prepared first officers for their DC-3 airline transport rating flight check. Each trainee had flown the first of the instruction periods the previous day when they flew 3 hr. and 50 min. in the same aircraft involved in this accident. There had been a 24-hr. rest period since that time.

A lead mechanic for Capital Airlines, who provided line service for training flight V-3, stated he observed Capt. Kinne in the copilot's seat and First Officer Tomkins in the left seat when the aircraft departed the ramp. It was later learned that Trainee Henderson occupied the jump seat at the time of departure.

According to Pilot-Trainee Tomkins, a pretakeoff aircraft and engine check was completed before accomplishing a simulated instrument takeoff from Washington National Airport. The departure was routine. Tomkins said that after takeoff he performed climbing turns, timed turns, turns in slow flight, and various other maneuvers.

At 1141 the crew of flight V-3 made one radio contact with the company, giving their ramp departure time, offtime, total fuel aboard, and estimated time of return, and stated they were switching over to Martinsburg Radio.

Flight Observed

The flight was observed in the vicinity of Martinsburg Airport at approximately 1200, practicing landings on runway 17. At 1256, the Martinsburg Air Traffic Communications Station contacted the flight, advised that Air National Guard jets would be using runway 8, and requested V-3 also to use runway 8.

Tomkins said he concluded his portion of the flight by completing a radio range approach at Martinsburg, followed by approximately seven touch-and-go landings simulating a 400-ft. ceiling and one-mile visibility. Several of these were executed with power retarded alternately on the engines to simulate engine failure. Following a final full-stop landing, the aircraft was parked and First Officers Henderson and Tomkins exchanged positions.

Following takeoff, Pilot-Trainee Henderson then performed three or four touch-and-go landings, all of which were flown with a simulated 400-ft. ceiling and one-mile visibility condition. Most, if not all, of these landings were simulated single-engine approaches with 2-engine go-around and on the final landing preceding the accident the right engine was stopped by moving the mixture control to idle-cutoff somewhere in the traffic pattern. This engine was then restarted and set at 1,500 rpm. and 15 in. manifold pressure (a no-thrust condition) to simulate a feathered propeller. The landing gear and flaps were fully extended in preparation for landing.

The flight was observed to abort the landing and start a go-around. While still at an altitude estimated to be 50 ft. and at a point approximately three-fourths of the distance down the 7,000-ft. runway, the aircraft entered a right turn making a bank of approximately 35 to 50 degs. The nose of the aircraft was observed to drop slightly, then rise again during the right turn. The right wing was then seen to contact tall trees, and the aircraft cartwheeled to the ground while traveling in a southerly direction.

The aircraft was extensively damaged at impact, and fire which followed consumed approximately 45% of the aircraft structure, particularly that area between the two engines and the forward passenger and crew compartments.

From examination of the terrain, the trees, and the aircraft structure, it was determined that the aircraft entered the wooded area in a steep right bank of approximately 80 deg. and came to rest on a heading of 320 deg. magnetic in a 30-deg. nose-down attitude. The point of impact was 1,165 ft. south of the centerline of runway 8-26.

All components of the aircraft remained in their relative positions after impact, although both engines were separated from the aircraft. The wing flaps and main landing gear were found fully retracted. Examination of the aileron, elevator, and rudder system controls revealed their cables to be intact from the control surfaces to the cockpit controls. Most of the control components in the fuselage and wings were extensively damaged by fire after impact, as well as by tree and ground contact. The rudder trim tab was found deflected eight degrees nose left.

Both engines were examined for evidence of malfunction. No. 1 (left) engine was relatively free of any fire damage to the nose and power section assemblies. All accessories were securely mounted on their pads and evidenced light to moderate fire damage.

The left throttle valves were found in the fully closed position. The left mixture control was in the full-rich position.

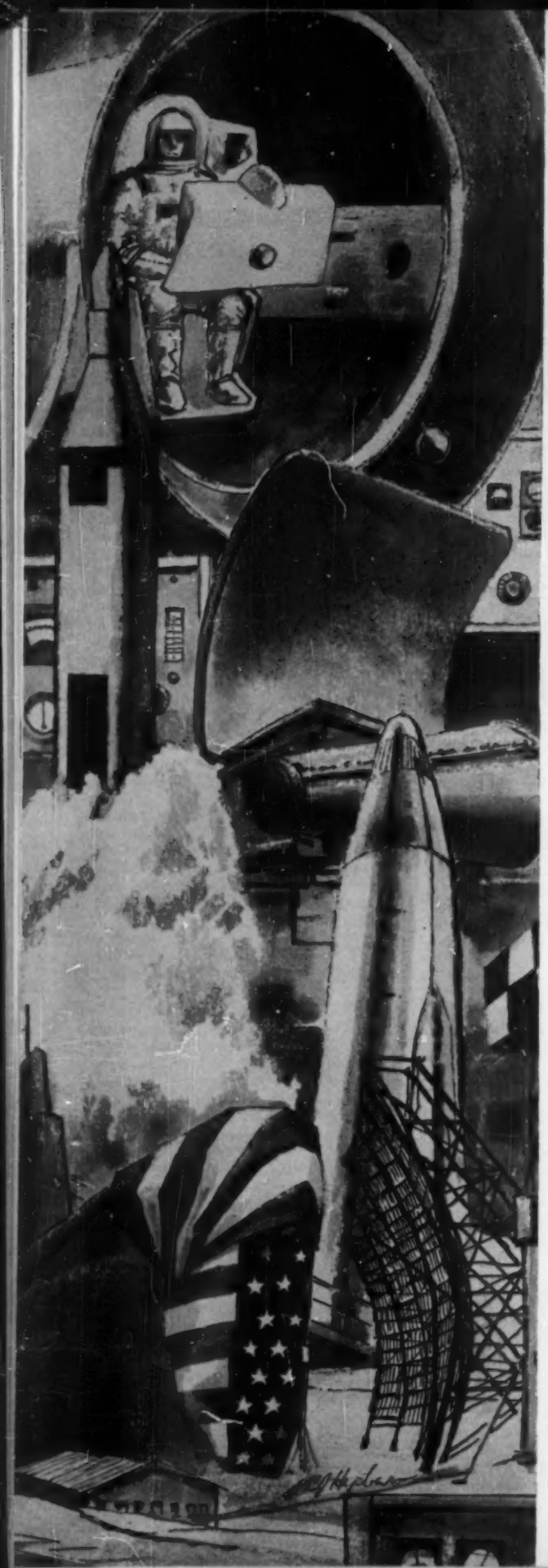
Engine Damaged

No. 2 (right) engine was extensively damaged by fire after impact. It was separated from the nacelle, and all fluid-carrying lines and wiring were extensively burned. All the accessories were damaged in various degrees by impact and subsequent fire. The right throttle valves were in the fully open position. The right mixture control was found in the auto-rich position. No. 1 and 2 carburetor heat doors were found in the fully closed and ¾-closed positions, respectively. There was no evidence of structural failure or malfunction to either engine prior to impact, nor was there any evidence of fuel contamination or exhaustion.

Examination of the propeller assemblies revealed no failures or difficulties of any kind. Blade angles of the left and right propellers at the time of impact were 19 and 16 deg., respectively, the latter being the low pitch stop position indicating little, if any, power.

Capt. Kinne stated that at least once while Tomkins was in the left seat and once while Henderson was flying, difficulty with the landing gear safety latch was encountered during gear retraction. This malfunction, according to Capt. Kinne, was caused

[1] All times are Eastern Standard based on the 24-hr clock.



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For more information—or for a copy of brochure GED-3760, describing the Department's defense systems capabilities—write to R. L. Shetler, General Manager, Defense Systems Department, P.O. Box 457, Syracuse, New York. 226-1

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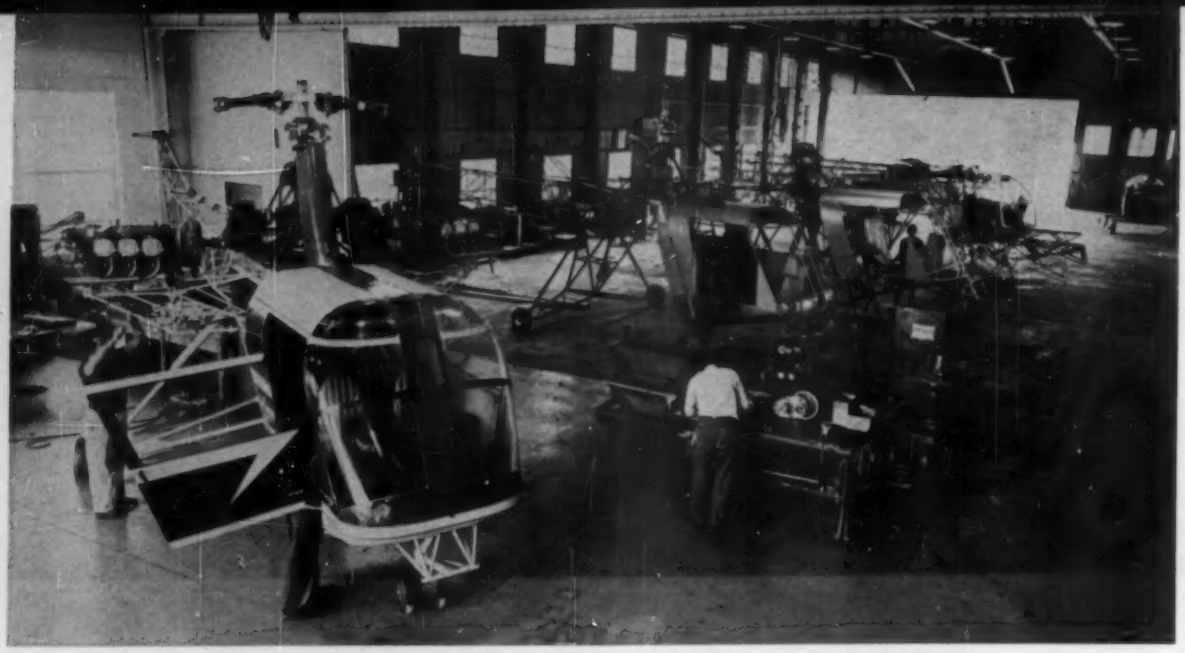

First Production Omega BS-12D Nears Completion

First production BS-12D twin-engine cargo/passenger helicopter nears completion at New Bedford, Mass., plant of Omega Aircraft Corp. Okanagan Helicopters, Ltd., has ordered three D-models (AW Aug. 17, p. 123). Fourth aircraft on the line is the BS-12 prototype; Bell 47G (top right) is privately owned. BS-12D powerplants are two 310 hp. Lycomings. Company now is designing a triple turbine version, using Allison T63 turbine engines (AW Aug. 24, p. 23).

by the lack of tension on the J-dog[a] spring located on the landing gear control valve, which prevented the safety latch from remaining in the upright or "latch-raised" position after it was manually pulled in preparation for raising the landing gear. A flight test was accomplished July 16, 1958, to evaluate the significance of the additional motions required to retract the landing gear.

Tests were made to determine the time of gear retraction with a simulated malfunctioning landing gear latch. It was determined that with the J-dog spring disconnected, simulating the conditions of a malfunctioning gear, the operator would have to allow from 5 to 10 additional seconds to actuate the landing gear retraction controls.

Tests were also made to determine whether power would be partially lost during an attempted go-around with the carburetor heat doors closed or partially closed. The simulation of several engine power conditions with full carburetor heat did not adversely affect the operation of the engine and each time the throttle was advanced the engine responded immediately with no indications of operating difficulty, giving adequate power to continue flight in all instances.

Capt. Kinne was appointed an instructor-pilot Oct. 14, 1957. He was relieved from instructor status Nov. 13, 1957, because of the reduced need for instructors. He was again designated as instructor-pilot Mar. 1, 1958. He had instructed a total of eight first officers for their captaincy checkout, only one of whom failed to pass his first flight check successfully. Capt. Kinne had a total of 910 hr. as captain in DC-3's and had accumulated 275 hr. as flight instructor on this type aircraft. He had a total time of 5,625 flying hours.

Both trainee-pilots had over 3,000 flying hours. First Officer Tomkins had 787 hr. in DC-3s, and First Officer Henderson had 681 hr. in DC-3s.

Trainee-Pilot Tomkins, who was seated in the jump seat at the time of the accident, stated he did not recall whether the wheels touched down or at what point power was applied for the go-around; however, he did remember seeing Capt. Kinne actuate the landing gear selector valve to raise the landing gear. Tomkins stated he then recalled the aircraft was in about a 10-deg. right bank and on a heading of about 30 deg. to the right of the runway heading, with a speed of about 60 kt. Following gear retraction, Tomkins stated, he saw Capt. Kinne's hands at the throttle quadrant and it appeared to Tomkins that the captain was attempting to restore power to the right engine. Tomkins recalled hearing Capt. Kinne state he had the controls a moment before hitting the trees.

Pilot Witnesses

Thirteen witnesses, several of whom were pilots with the West Virginia Air National Guard and flew Air Guard C-47 type aircraft, observed the approach to the runway, the attempted go-around, and the final crash. One Air National Guard pilot, who was located in the mobile control tower at the threshold of Runway 8, stated that the aircraft "did not touch down and proceeded to go around." A second witness, located further down the runway, confirmed this.

An application of power, described by a few observers as normal for takeoff, was heard. A majority of the witnesses agree that the landing gear was retracted as the aircraft continued its climbout. The attitude of the aircraft during the climbout was variously estimated as being from a slight climb to a nose-high mushing attitude approaching a stall. No fire or smoke was observed while the aircraft was in flight and no parts or pieces were seen to fall from it.

Several eyewitnesses stated they saw the right propeller windmilling following the application of power to go around. One witness stated, "the left engine appeared to be developing a considerable amount of power." According to a few witnesses, considerable power was being developed by both engines.

Prior to the accident Pilot-Trainee Henderson completed three or four touch-and-go-landings, several of which were single-engine approaches. According to Capt. Kinne, these approaches and landings were "not good." Qualified witnesses in proximity to the runway also agreed with this. One witness, after watching the next to last touch-and-go, stated that after takeoff he saw the aircraft start abruptly off the runway in an approximate 15-deg. nose-high attitude, climbing to about 200 ft. It was then observed to nose over and descend to about 75 to 100 ft. above ground, pick up speed, and continue on around. Another witness, an Air National Guard pilot, described the three landings preceding the accident as very poorly executed.

Capt. Kinne stated he pushed both propeller controls forward to the full low-pitch takeoff position prior to calling for the balked landing. Pilot-Trainee Henderson was aware that he was to shoot a touch-and-go landing. At the last moment, just as the aircraft was about to flare out at an airspeed of between 60 and 70 kt., the instructor called for a balked landing and told Henderson to, "Take it around, both engines." At this moment, Capt. Kinne diverted his attention to raising the flaps and retracting the landing gear at Henderson's order.

Capt. Kinne and Pilot-Trainee Tomkins

[a] The J-dog is a component of the landing gear safety latch assembly which allows movement of the landing gear valve selector handle to the up position.

stated Henderson advanced the throttles. Capt. Kinne stated both throttles were advanced. Pilot-Trainee Tomkins could not recall whether Henderson advanced one or both throttles to full power.

Capital Airlines' standard procedure for simulated engine out is as follows: After an engine is cut in the landing pattern it is set at 1,500 rpm. and 15 in. of manifold pressure to simulate engine failure. Landing gear and flaps are extended when it is certain the field can be reached. On the final approach, rudder trim tab is straightened before getting too close to the airport. Propeller controls are advanced to the low-pitch, takeoff position. Standard procedure calls for all go-arounds to be made with two engines at takeoff power whenever the airspeed drops to less than 74 kt. while flying on single engine.

ANALYSIS

Pilot-Trainee Henderson and Capt. Kinne were both familiar with single-engine landings, and two-engine go-arounds. Henderson had observed several single-engine approaches with touch-and-go landings while Tomkins was flying. Henderson then moved into the left pilot's seat and made several single-engine landings followed by two-engine go-arounds prior to the accident. Henderson's touch-and-go landings were poorly executed and, since this was his first balked landing, it behooved Capt. Kinne to monitor the instruments and the go-around carefully.

It will be recalled that the final approach to the landing was made under simulated single-engine approach conditions. The right engine had been retarded to 1,500 rpm. and was only drawing 15 in. of manifold pressure.

The pilot had cranked in eight degrees, or full nose-left rudder trim, the landing gear was down, and flaps were fully extended. It is evident that the aircraft was in its landing flareout, at an airspeed of between 60 and 70 kt., when the order to abort the landing was given with the command from Capt. Kinne to, "Take it around —both engines."

Following the captain's command, the chronological sequence of actions would have been for the pilot-trainee to advance both engines to full power position, and call for flaps and gear up in that order. According to company practice and good operating procedures, the rudder trim should have been returned to the neutral position during the approach. However, investigation at the wreckage area subsequently disclosed that the left rudder trim settings had not been changed, which would indicate that the trim mechanism had not been actuated. Even though the rudder trim was not returned to neutral and even if there was an actual or simulated loss of powwer of one engine, the trainee-pilot should have been able to maintain minimum control speed.

An examination of the maintenance records revealed no recent history of a malfunctional landing gear selector assembly and the failure must have arisen in flight.

Capt. Kinne, who was serving as copilot far Trainee Henderson, was responsible for retracting the gear and flaps in the situation described. Because of the gear latch malfunction, Capt. Kinne, in order to raise the gear, had to unfasten and pull up on the gear safety latch with one hand and pull up the landing gear valve control lever with the other. This would add additional time to the gear retraction process and result in the captain leaning over to the left with his head down. In this position it would have been almost impossible for him to monitor the instrument panel or the trainee-pilot's actions for several critical seconds during the go-around.

Investigation disclosed that the blade angles of the left and right propellers were positioned at 19 deg. and 16 deg., respectively. The propeller blades of this aircraft were of the type that permitted constant-speed operation from a low-stop position of 16 deg. to a fully feathered position of 88 deg. According to Capt. Kinne, both propeller control levers were advanced to takeoff rpm. prior to attempting the go-around. This could not be confirmed because the propeller governor control pulleys were disconnected at impact. However, there is no reason to believe both propellers were not set at the 2,400 rpm. takeoff position.

The left engine, with an rpm. of 2,400, would have been developing between 887 and 952 hp. for an airspeed of between 60 and 70 kt., and a blade setting of 19 deg. By the same reasoning, the right engine, with an rpm. setting of 2,400 would have been developing anywhere from zero to 650 hp. with the same airspeed, and a blade setting of 16 deg.

With the airspeed at or near minimum control, as was the case in this accident, the right propeller blades would position to

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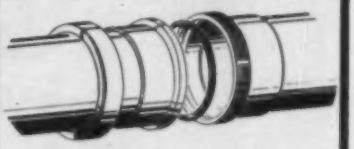

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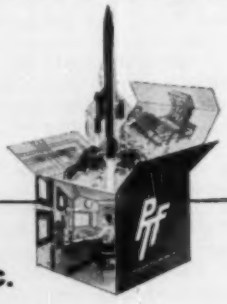

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the 16-deg. stop if a malfunction of engine occurred, since the propeller go ernor would try to compensate for loss of rpm. Under the same conditions, the propeller blades would remain on the 16-deg. stop position if the throttle was not advanced and the propeller was in the forward low-pitch high rpm. position. Under these circumstances, right propeller in the 16-deg. stop position, either the right engine failed to develop its normal power or Pilot-Trainee Henderson failed to advance the right engine throttle.

CONCLUSIONS

After evaluating all evidence, the Board concludes that Pilot-Trainee Henderson attempted a single-engine go-around following a single-engine approach; that he tried to climb the aircraft on one engine at an airspeed below minimum control speed, and that Capt. Kinne's attempt to rectify this situation was made too late to prevent the accident. Pilot-Trainee Henderson apparently misunderstood Capt. Kinne's instructions to, "Take it around—both engines," and did not advance the right throttle for the two-engine go-around. Capt. Kinne was distracted, momentarily, in his supervision of Henderson because of the malfunctioning landing-gear latch.

Pilot-trainee Henderson's actions were inconsistent with the degree of competence expected of a first officer. He was about to be upgraded to captain and had over 3,000 flying hours, 681 of which were in DC-3's. Nevertheless, the captain-instructor pilot, Capt. Kinne, was instructing Henderson and the final responsibility for the safety of the crew and aircraft was his.

Following this accident, Capital Airlines designated a qualified senior instructor on DC-3 equipment who will be charged with responsibilities for conducting and supervising all flight training for initial upgrading. This senior instructor will select and standardize a sufficient number of line training captains so that a DC-3 training supervisor will be available at each base that operates DC-3 equipment.

In addition to this staffing change, Capital Airlines took further corrective action by instituting a procedural change for DC-3 instructors. This change requires that the decision to either continue or abandon a single-engine approach to a landing be made before reaching an altitude of 200 ft.; or, if a single-engine landing is made, the aircraft must be brought to a full stop.

The Board determines that the probable cause of this accident was that, following the trainee-pilot's failure to maintain minimum-control speed during an attempted go-around, the instructor-pilot failed to take control of the aircraft in sufficient time to prevent a critical loss of altitude. A contributing factor was the malfunction of the landing gear latch which delayed retraction of the landing gear and caused the distraction of the instructor-pilot for several seconds during a critical period of the go-around.

By the Civil Aeronautics Board:
James R. Durfee
Chan Gurney
Harmar D. Denny
G. Joseph Minetti
Louis J. Hector, concurring and dissenting

Following is Hector's concurrence and dissent:

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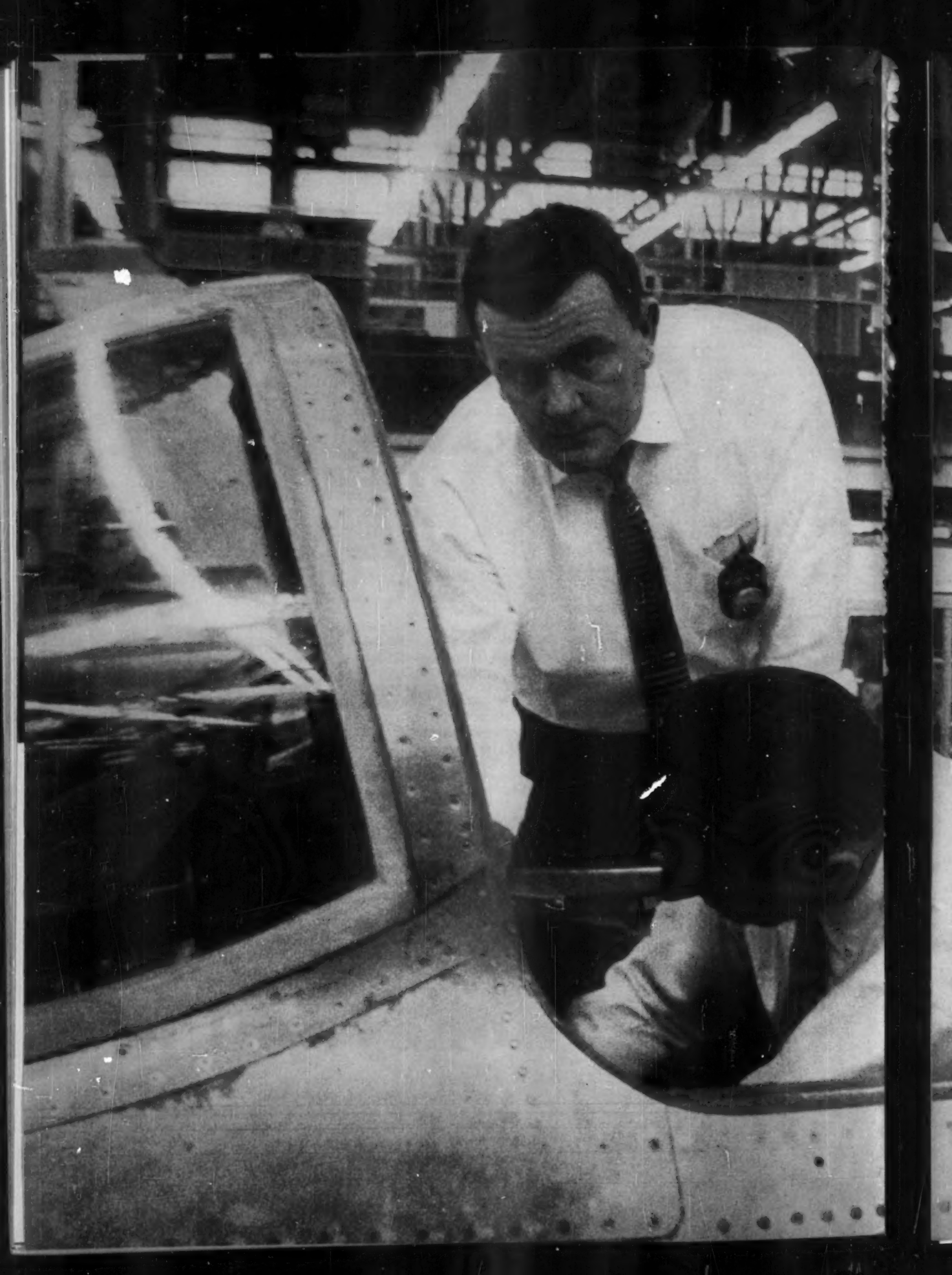

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I cannot concur in the probable cause of this accident as found by a majority of the Board. I agree with the factual report of the investigation and with the factual deductions made by the Board, but I cannot agree with the finding of pilot responsibility in the Board's statement of probable cause. I feel that such a finding is beyond the proper scope of an accident report.

Stripped of qualifying clauses, the Board has here determined that "The probable cause of this accident was that . . . the instructor-pilot failed to take control of the aircraft in sufficient time to prevent a critical loss of altitude."

It would find rather that the probable cause of this accident was the failure to maintain minimum control speed during an attempted go-around.

We are dealing in this case not with a student pilot or with a pilot whose lack of experience was such that the instructor-pilot must clearly be held responsible at all times for the performance of the aircraft. Henderson was a first officer of long experience. He had over 3,000 hr. of flying time, including 681 hr. in a DC-3. He was being checked for a captain's rating. Under these circumstances, whether or not Capt. Kinne must bear full responsibility for the safety of the aircraft is by no means clear. I therefore think that the Board should confine itself to an accurate description of the sequence of events and a statement of the mistake in judgment which was responsible for the accident, leaving such matters as responsibility and liability to the pilot certificate procedures of the FAA, and to the courts if the issue of liability is raised therein.

The Board has always attempted to keep matters of liability and responsibility out of its accident investigations. The success of these investigations depends upon the cooperation of all parties, and their being kept non-adversary in character. While the mere recital of the factual chain of events and the factual cause of an accident may carry grave implications of responsibility or liability, the Board has always endeavored so far as possible to keep legal conclusions out of its accident reports.

The matter of pilot responsibility has a long and somewhat inconsistent history. The basic case is *Smith, Airman's Certificate*,[8] decided in 1947, invovling a midair collision caused by the failure of the pilots to keep a proper lookout. It was an airman certificate case and Capt. Smith, of course, had a full opportunity in an adversary proceeding to present arguments in his behalf.

Subsequent safety cases have not followed the Smith doctrine. In Administrator vs.

---

[8] 13 C.A.B. 117 (1947). The Board stated: "Respondent Smith was the first pilot, and as such the pilot in command of the aircraft . . . In this case Captain Smith failed to maintain a proper lookout himself or to have an effective arrangement with his co-pilot to insure the maintenance of such lookout. Such failure was negligence on the part of Captain Smith." It is noteworthy that the Board in an accident investigation report (Transcontinental and Western Air DC-3-Boeing A75N1 training plane near Chicago, Ill.—September 26, 1945) covering the same incident did not attempt to assess specific responsibility. The Board there found the following probable cause: "Upon the basis of the foregoing the Board determines that the probable cause of this accident was lack of vigilance on the part of the pilots of both aircraft. Reduced horizontal visibility may have been a contributing factor."

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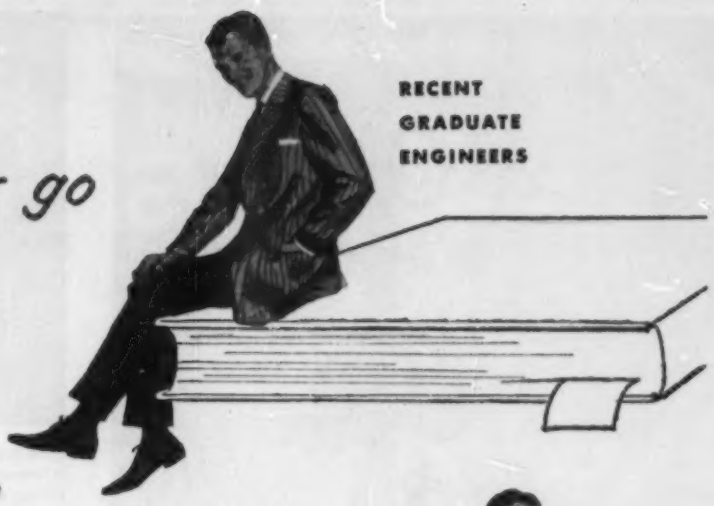

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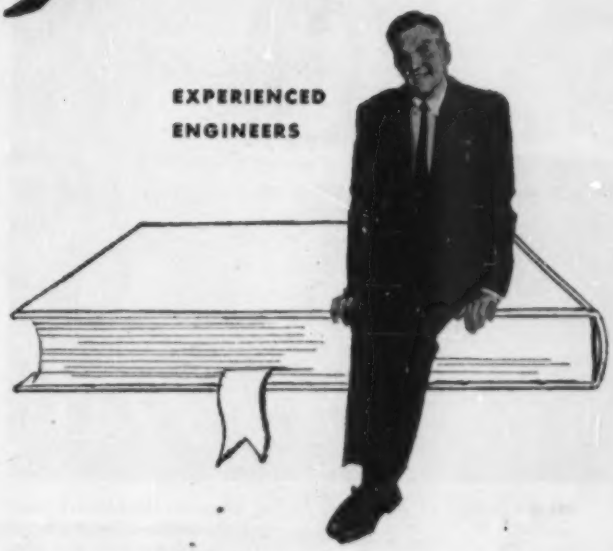

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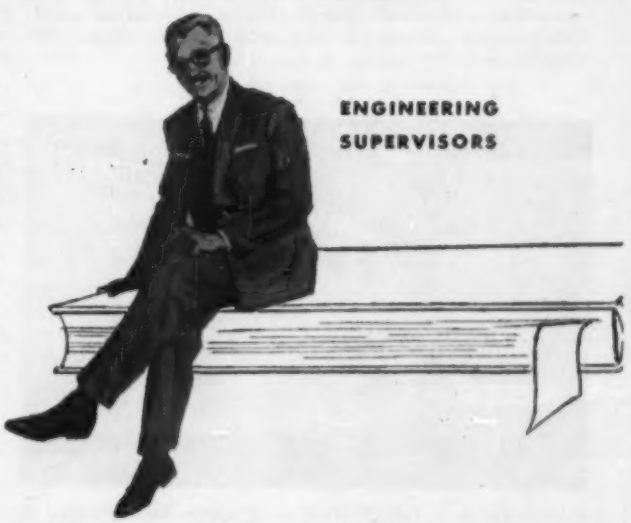

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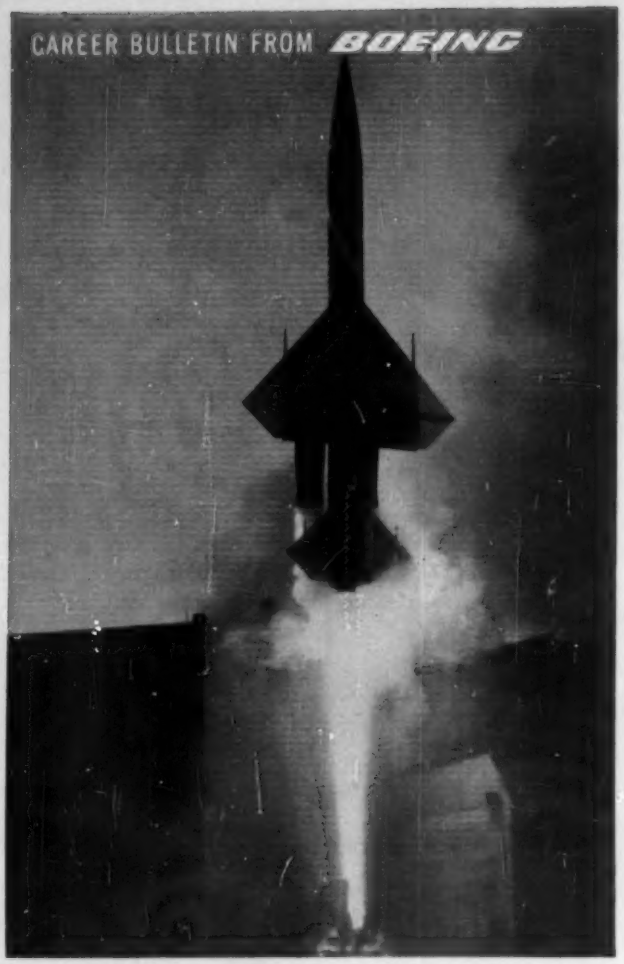

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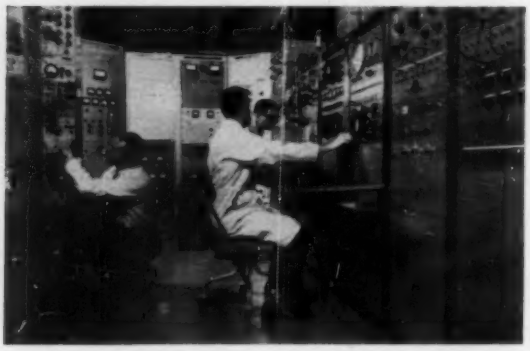

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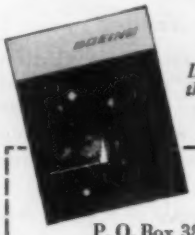

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Hazen,[4] decided in 1958, for instance, the Board overruled the examiner's initial decision which had found the captain negligent under the "command pilot" doctrine. In this case the CAA specifically requested additional argument on the captain-in-command issue, which I would have granted, but the Board dismissed the petition apparently on the grounds that the Smith case did not impose absolute responsibility on the command-pilot. In a recent report on an accident which occured while a CAA Inspector was conducting a flight-check, the Board did not reach a conclusion that any over-riding responsibility attached to the inspector-pilot.[5] Despite these two recent cases, the majority in this accident report now asserts the full pilot-in-command doctrine and builds around it the whole finding of probable cause.

During the period when the Civil Aeronautics Board was responsible both for accident investigation and for the issuance of Civil Air Regulations a certain confusion between our responsibilities in these respective fields may have been inevitable and in any event did not create any jurisdictional problems. Today, however, we no longer have the responsibility for the formulation of Civil Air Regulations and it seems to me, therefore, that the basic determination of the responsibilities of various members of the crew is beyond the proper scope of our authority.

As I stated above, if it were absolutely clear under the Civil Air Regulations or under the customs of the air, that the captain in this precise type of situation has absolute responsibility, the Board might possibly find his failure to act the probable cause. Since absolute responsibility of the type imputed in the present case is by no means clear, however, I think that question should be left to proceedings where the issue of responsibility and liability can more appropriately be determined.

When powers which have for many years been placed in a single agency are divided between two agencies, each much exert the greatest care and discretion to disentangle those powers and responsibilities in accordance with the new statutory scheme and to avoid encroaching upon the jurisdiction of the other agency. If absolute responsibility is to be placed on an instructor-pilot in this kind of situation, then that responsibility must be placed by the FAA under appropriate rule-making procedures or by an airman certificate proceeding rather than by the CAB as a part of an accident investigation.

One other aspect of the Board's finding disturbes me. If the FAA should institute an airman certificate proceeding against Capt. Kinne, those proceedings may well come before this Board on appeal. In such a case the Board may seem to prejudge the matter by making a clear finding of respon-

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[4] *Administrator v. Hazen*, S-853, February 12, 1958.

[5] *Aircraft Accident Report, Beechcraft Travel Air, N 819B, Near Little Rock, Arkansas, July 22, 1958.* The Board's finding of probable cause reads simply: "The Board determines that the probable cause of this accident was the unintentional entry into a spin at too low an altitude to recover." In this case we further concluded that one of the accident factors may have been the inspector's unfamiliarity with the aircraft in question which would appear to heighten the degree of his responsibility.

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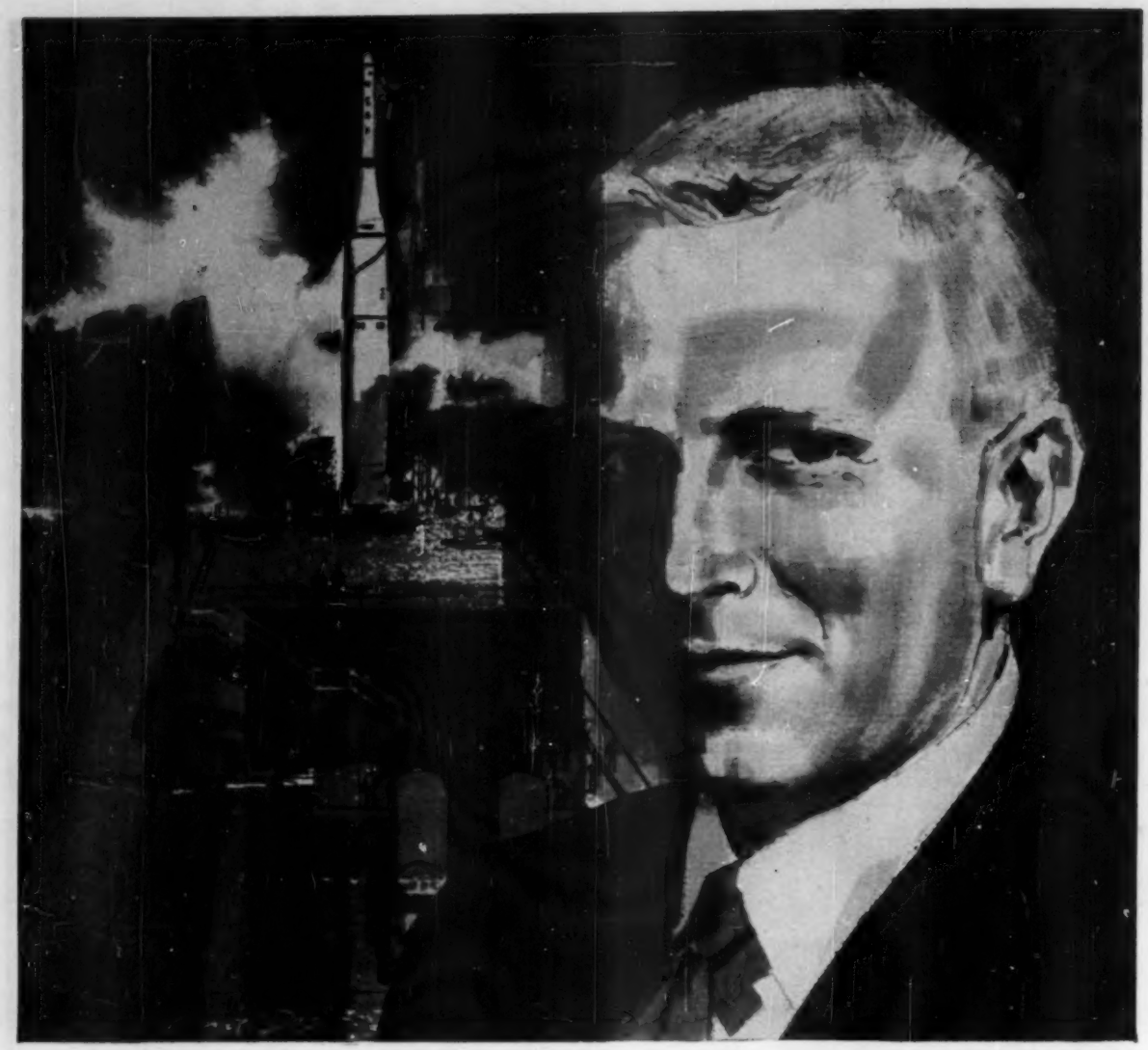

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sibility in its accident investigation report. In extraordinary cases such a finding may be inescapable, but there is clearly no need to make such a finding in the present case. This type of situation—the overlap between a certificate case and an accident investigation—has recently given the Board difficulty in the case of Administrator vs. Welling, although in that case the finding in the accident investigation was largely factual in character. The confusion between the two types of proceedings is compounded if the Board, as it does here, makes not only factual findings but also a finding of responsibility in an accident report prior to a possible hearing on an airman certificate appeal.

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of this accident immediately after occurrence. An investigation was initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. Depositions were taken at Washington, D. C., on July 10 and Aug. 15; at Martinsburg, W. Va., on July 11; and in Kansas City, Mo., on Aug. 13, 1958.

Capital Airlines Inc., is a Delaware corporation and maintains its principal offices in Washington, D. C. The corporation holds a current certificate of public convenience and necessity issued by the Civil Aeronautics Board to engage in the transportation of persons, property, and mail. It also possesses a valid air carrier operating certificate issued by the Civil Aeronautics Administration (now FAA).

Capt. James B. Kinne, instructor, age 34, was employed by Capital Airlines on July 2, 1951. He held a valid airman certificate with an airline transport rating for multi-engine land aircraft, Douglas DC-3, and lockheed Constellation. Capt. Kinne had a total of 5,625 flying hours, of which 1,600 were in DC-3 equipment. He had received his last semiannual proficiency check Jan. 30, 1958, and had passed his CAA physical on Feb. 25, 1958. He was assigned as a flight instructor Oct. 14, 1957.

Trainee First Officer Leighton R. Tomkins, age 31, was employed by Capital Airlines June 6, 1955. He held a valid airman certificate with an airline transport rating for multi-engine land aircraft, and had a total of 3,333 flying hours, of which 787 were in DC-3. His latest CAA physical examination was passed Mar. 21, 1958; his last semiannual proficiency check was Jan. 29, 1958.

Trainee Edwin A. Henderson, age 30, was employed by Capital Airlines April 25, 1955. He held a valid airman certificate with commercial pilot rating for single-engine land and sea aircraft, and instrument rating. He had a total of 3,921 flying hours, of which 681 were in the DC-3. His latest CAA physical examination was passed April 7, 1958; his last semiannual proficiency check was passed on Nov. 24, 1957.

N 49553, a Douglas DC-3, manufacturer's serial number 4820, had a total of 32,296 hr. 48 min. of flying time. It was equipped with Wright model G-202 A engines, Hamilton Standard model 23E50 propellers with model 6353A-18 blades, and was currently certificated by the Civil Aeronautics Administration.

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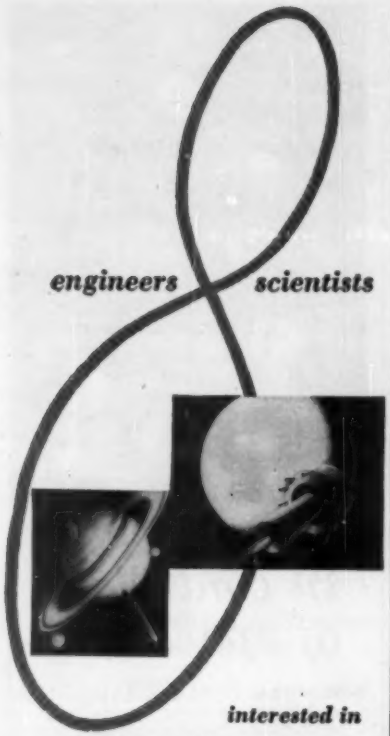

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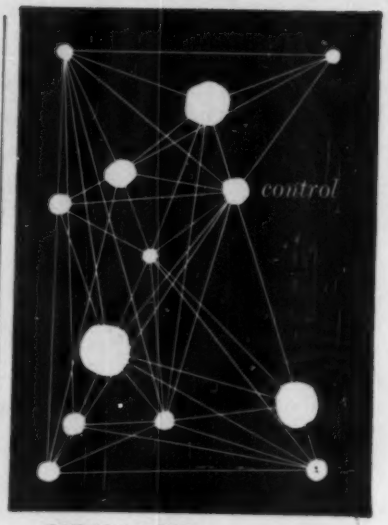

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REQUIREMENTS Strong background in analog and digital computer design through fire control, bombing, navigation and/or data processing system development. First hand computer circuit and control system design experience. Technical project direction with emphasis on system engineering

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ADVERTISERS IN THIS ISSUE

AVIATION WEEK, AUGUST 31, 1959

A.C. SPARK PLUG THE ELECTRONICS DIVISION OF G.M.C. 127
AEROJET GENERAL CORP. 130
ALLIS-CHALMERS HYDRAULIC DIV. 82
ALPHA CORPORATION 11
AMERICAN BOSCH ARMA CORP., ARMA DIV. 62
AMERICAN MACHINE & FOUNDRY CO. 6
AMPEX CORPORATION 35, 75
AVCO CORPORATION (RESEARCH & ADVANCED DEVELOPMENT 91

BELL HELICOPTER CORP. 16
BLISS CO., E. W. 65
BOEING AIRPLANE CO. 111, 128
BRUNSWICK-BALKE-COLLENDER CO. 18
BUCKEYE IRON & BRASS CO. 63
BURROUGHS CORP. 110

COLLINS RADIO CO. 48
CONSOLIDATED FILM INDUSTRIES 97
CONVAIR DIV. GENERAL DYNAMICS CORP. ..105-106
CORNELIUS CO., THE 37

DEL MAR ENGINEERING LABS. 6
DELANEY GALLAY, LTD., VULCAN WORKS 44

EX-CELL-O CORPORATION 4

FAIRCHILD CONTROLS CORP. 70-71
FLIGHT REFUELING INC. 101

GARRETT CORP. 22, 121, 137
GENERAL ANILINE & FILM CORP. 104
GENERAL ELECTRIC CO. ..14-15, 79, 81, 83, 96 118-119
GENERAL ELECTRIC CO., COMPUTER DEPT. 13
GILFILLAN BROTHERS 20
GIANNINI CONTROLS CORP. 68
GOODYEAR TIRE & RUBBER CO. 3

HEXCEL PRODUCTS, INC. 12
HILLER AIRCRAFT CORP. 116
HOLLEY CARBURETOR CO. 114-115
HYDROMATICS, INC. 9

INTERNATIONAL BUSINESS MACHINES CORP. .. 38
INTERNATIONAL NICKEL CO., INC. 10

JOHNS-MANVILLE 103

KEARFOTT CO., INC. 64

LINDE DIV. OF UNION CARBIDE CORP. (NEW PRODUCTS DEPT.) 24
LISLE CORP. 73
LITTON INDUSTRIES ELECTRON EQUIPMENT .. 90
LOCKHEED AIRCRAFT CORP. 46

MARQUARDT AIRCRAFT CORP. 84-85
M-D BLOWERS, INC. 73
MINNEAPOLIS HONEYWELL REGULATOR COMPANY 123

NATIONAL UTILITIES CORP. 121
NORTHROP CORPORATION 76-77

PACIFIC SCIENTIFIC CO. 88
PARKER SEAL CO., A DIV. OF PARKER-HANNIFIN CORP. 78
PHILCO CORP., LANSDALE TUBE DIV. 108
PRE-FLITE INDUSTRIES CORP. 87
PROPULSION TEST FACILITIES, INC. 100

RADIO CORP. OF AMERICA ..... 3rd Cover
RAYTHEON MANUFACTURING CO. 129
RED BANK DIV., BENDIX AVIA. CORP. 5
REPUBLIC STEEL CORP. 88-89
ROHR AIRCRAFT CORP. 131
RYAN AERONAUTICAL CO. 126

SERVOMECHANISMS, INC. ..... 4th Cover
SOCONY MOBIL OIL CO., INC. 122
STANDARD PRESSED STEEL CO., AIRCRAFT/MISSILES DIV. 38
STANDARD STEEL CORPORATION 17

TASK CORPORATION 60
TELEFLEX, INCORPORATED 82
TRANSITRON ELECTRONIC CORP. 7
TUBE METHODS, INC. 72

VOI-SHAN MANUFACTURING COMPANY ..2nd Cover

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 132-136

EQUIPMENT (Used or Surplus New) For Sale 136

WANTED Equipment 136

WHERE TO BUY 136
Murray Co., Inc., A. B. 136

ADVERTISERS INDEX

Aaxico Airlines 136
Avco Research & Advanced Development 135
Bosch Aircraft Corp. 132
California Airmotive Sales Corp. 136
Engine Works 136
Erco Research & Development Group 134
General Electric Small Aircraft Engine Dept. 136
General Electric Missile & Space Vehicle Dept. 133
General Precision Laboratory, Inc. 135
Honeywell, Aeronautical Div. 133, 135
Kaman Aircraft Corp. 135
Minneapolis-Honeywell 134
Rommert-Werner 136
Solar Aircraft Co. 132
Sunstrand Aviation Corp. 133
Thompson Aircraft Sales 136

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LETTERS

Pleasant Flight

Last year, following a controversial letter ("Group Air Travel," AW July 28, p. 94), I stated my first personal experience which culminated in the letter "Successful Charter" (AW Sept. 1, p. 90).

Last year, in my letter, I made one prime suggestion, namely, "Better planning to ensure that planes leave on time."

This year, on July 17 and on Aug. 1 to be exact, a group of 85 adults and four children flew on Air France Flight 0430 and 023, respectively.

This last experience was a huge success for the following reasons:

1. Air France flights left on time (and I mean on time).

2. Air France service on board was outstanding.

All this for less than $300 round trip from New York to Paris. Let me explain what I mean.

Air France Flight 0430 was scheduled to leave Idlewild Airport at 5:30 p.m. on July 17. At exactly 5:30 p.m., engines running, the door closed, the aircraft started taxiing into position for takeoff.

For the return flight from Paris-Orly, we were scheduled to leave at 11:10 p.m. At exactly 11:10 p.m. the plane was taking off from the runway.

As far as the service was concerned, everybody in the group was amazed at the display of efficiency and courtesy extended to us.

The food was excellent and we were given some extra privileges usually reserved for first-class travel, such as free drinks of all kinds, excellent French wines and champagne—Moet and Chandon, if you please.

I'm more than ever convinced that industrial groups are a natural for this type of travel whether it be for a vacation or a convention.

I must also repeat my conviction that "this type of operation can have a very important long-range benefit to commercial aviation."

PAUL H. DORES
Standards Engineer
American Bosch Arma Corp.
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Autopilot Use

I'm speaking as a rank amateur, but I've got to get it off my chest. I say "amateur," because my flying is limited to lightplanes.

The recent losses of planes in the vicinity of thunderheads has caused concern in the minds of prospective passengers who I know. They feel that once they board their flight they are in the hands of the pilots, and that they, the pilots, are apt to take them right into the center of the first thunderhead they see and that they will be struck down by lightning. It has always been told me that the only contact a plane would have with lightning (unless, by the sheerest accident, the plane would get in the course of a "bolt") would be from the "fire." I've had one experience with the "fire" and it scared the pants off me—and I was very glad that I had an autopilot aboard and that it was activated at the time.

Which brings me to the point of this letter. As I understand it, some airlines will not install autopilots on their ships. I've heard various reasons for the action, but I would think that the experiences of some of the lines would tend to give second thought to the subject. From my experience with the "fire," I know that it was a full five minutes before my vision returned to normal. Perhaps, with the plane I was flying, had I flown "hands-off" all would have been well. These boys, however, are flying planes that "keep them honest" and must be on the wheel pretty nearly all of the time. Couldn't it be possible that they were blinded by a flash of lightning and just plain went out of control? Wouldn't it be wise to have autopilots on all commercial transports as a protection to planes and passengers? I know that Mr. Rickenbacker feels that autopilots tend to make too much laxity in the "office." It could be true, but I think that the time of recovery of vision being cared for by the "iron man" might make up for a lot of goofing-off.

CHARLES H. EVOY, JR.
Jenkintown, Pa.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Airport Noise

Jet transports, as with many other things, have had their share of public disapproval —for instance, London and New York. Now a similar situation, which I wish to draw to your attention, is developing here concerning the Los Angeles International Airport.

Enclosed you will find part of a front page from a local newspaper showing adverse activity to jet aircraft with, ironically enough, on the same page references to current prosperity linked to the flight operations of the International Airport.

Briefly, the situation is this. Since the 707 operations have begun many people have moved out of the area to other districts. As a result the local landlords have lost money so they have been instrumental in getting together a local committee with a high sounding title to gather all possible complaints and make recommendations. Some of these can only be termed ridiculous (unless you prefer inane).

As examples: The low flying jets are a danger in that they might crash. They should use less power (in landing). They make too much noise.

This phobia against jet aircraft has gone to the extent that turboprop aircraft are included along with the straight jets when actually the F-27s and Viscounts used to make much less noise than many piston engined aircraft.

It is proposed, after some meetings, to bring court action against companies using jet airliners.

My answers to these objections are as follows: With respect to landlords, this is not a high class residential district, even if the rents are. It is a recognized thing that around railroad stations, docks, and airports, rents are lower. Here, however, large numbers of people have been moving into the area, many of them aircraft workers, with the result that the local landlords have been able to get away with charging exorbitant rents. Now that they stand to lose some of that money, they are squealing.

The airport was here before most of those landlords so, if they don't like it, I would suggest they go elsewhere.

As regards flying the 707s, actually they come in no lower than the other airliners, they just look that way. There is certainly no more danger of a crash with a jet than one of the older airliners. Many times I have seen DC-7s with one engine stopped or in other difficulties, but there has been no protest.

In the case of using less power in landing, very often the 707s have to increase power to reach the runway when they are in the last stage of their approach.

It is possible that some of these recommendations are already being experimented with, judging by the activities of some of the airliners recently. It is somewhat disturbing to see a TWA 707 descend like an express elevator and pull out at a low altitude 3,000 ft. from the end of the runway.

From the general noise point of view, I live at one side of the approach pattern and one mile from the end of the runway but I am not particularly bothered by jets, although I live nearer to them than many who are raising the complaints. In fact, peoples' radios and traffic make more disturbance than an occasional jet.

It is interesting to note the intention of bringing court cases against the airline companies.

If it were not for the aircraft industry here, along with the airline companies, Inglewood and much of this part of Los Angeles would be nothing.

Probably the most disturbing factor is that the FAA is seriously considering these objections and recommendations. It is certain that some cases have needed improving in the past but not these present objections. I hope soon to make use of 707 service myself, but I want to feel that when I do so it will be in safety and not in some hazardous situation brought about by a weak-kneed FAA bending before the hot verbal gas emitted by a local group which was inconvenienced to the extent of a few dollars.

LEONARD E. CAPON
Inglewood, Calif.

new wings for words

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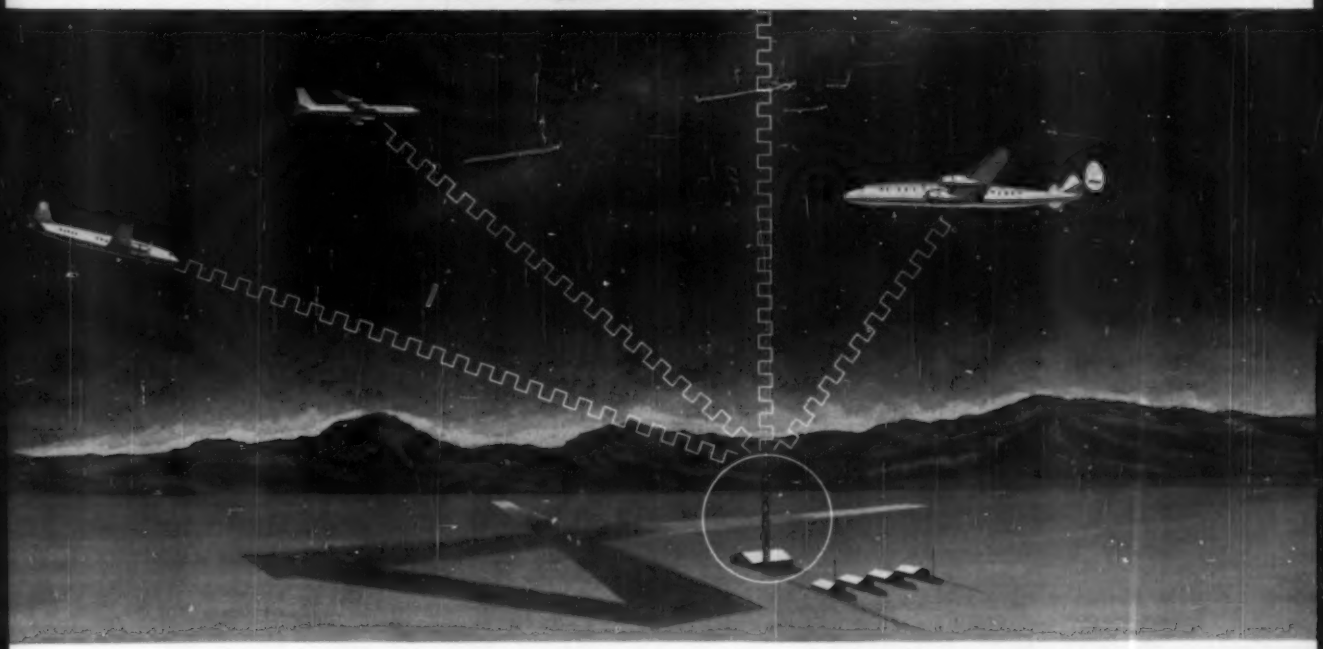

AGACS, Experimental Automatic Ground/Air/Ground Communication System is a new concept in Air Traffic Control Communications to meet the accelerated pace of increased air traffic. Primary objectives are efficient usage of frequency spectrum, added safety through increased reliability and reduced burden to pilot and controller, and adaptability to all classes of aircraft. AGACS provides compatibility with existing ground and airborne communication equipment, selective addressing of information, and a minimum number of frequency changes during flight. The system utilizes two-way time division data transfer over existing ground and air communication links to provide an automatic, mutual exchange of information. The airborne facilities display to the pilot the last significant Air/Ground and Ground/Air message quantities, while the controller may recall from central memory-storage equipment the last Air/Ground and Ground/Air message quantities for display. The AGACS program is still in the developmental stage. In August, 1959, RCA provided initial models of both airborne and ground equipments for the Bureau of Research and Development of the Federal Aviation Agency for extensive experimentation and flight tests.

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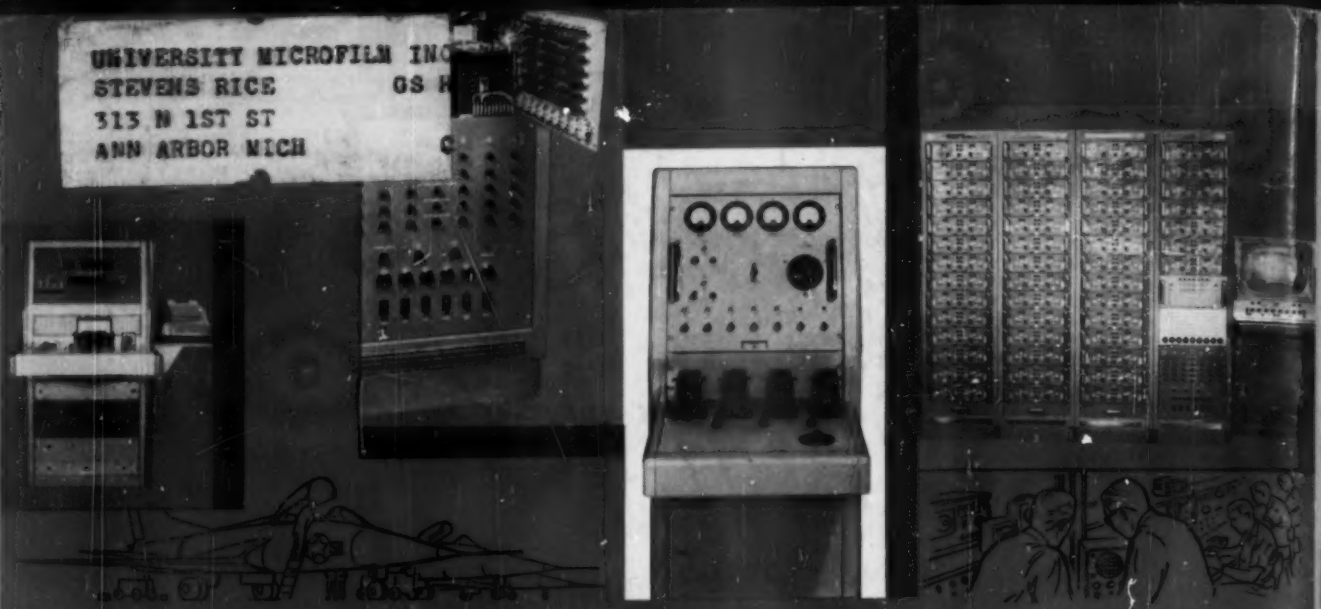

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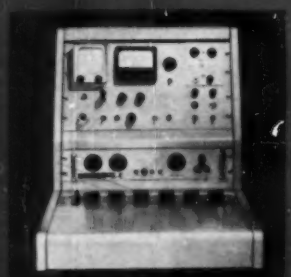

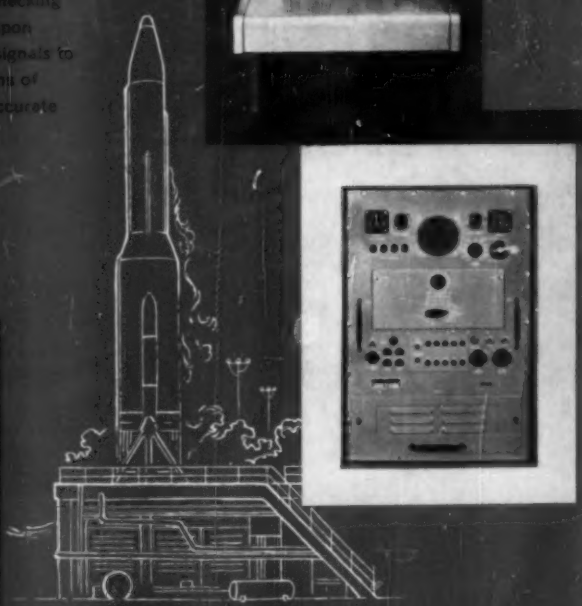

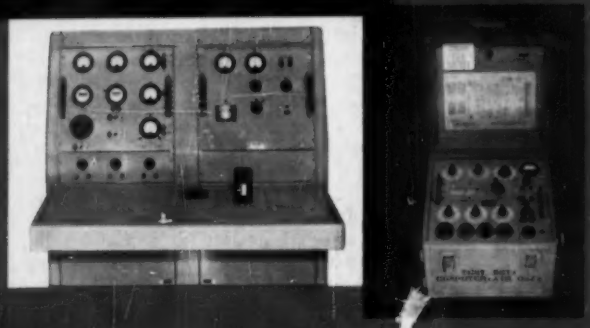

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